
THE WORLD WAR II ORDNANCE DEPARTMENT'S GOVERNMENT-OWNED CONTRACTOR-OPERATED (GOCO) INDUSTRIAL FACILITIES: RAVENNA ORDNANCE PLANT HISTORIC INVESTIGATION

by
Rita Walsh
of
Gray & Pape, Inc.

U.S. ARMY MATERIEL COMMAND HISTORIC CONTEXT SERIES
REPORT OF INVESTIGATIONS
NUMBER 7A



GEO-MARINE, INC.

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REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE					
4. PERFORMING ORGANIZATION REPORT NUMBERS U.S. Army Materiel Command Historic Context Series Report of Investigations Number 7A			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a. NAME OF PERFORMING ORGANIZATION Geo-Marine, Inc.		6b. OFFICE SYMBOL (if applicable)	7a. NAME OF MONITORING ORGANIZATION US Army Corps of Engineers, Ft. Worth District		
6c. ADDRESS (City, State, and Zip Code) 550 E. 15th Street / Plano, Texas / 75074			7b. ADDRESS (City, State, Zip Code) PO Box 17300 Fort Worth, Texas 76102-0300		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION US Army Corps of Engineers, Fort Worth District		8b. OFFICE SYMBOL (if applicable)	9. PROCUREMENT INSTRUMENT ID NUMBER DACA63-93-D-0014, Delivery Order No. 014		
8c. ADDRESS (City, State, Zip Code) PO Box 17300 Fort Worth, Texas 76102-0300			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.
11. TITLE (Include Security Classification) The World War II Ordnance Department's Government-Owned Contractor-Operated (GOCO) Industrial Facilities: Ravenna Ordnance Plant Historic Investigation					
12. PERSONAL AUTHOR(S) Rita Walsh					
13a. TYPE OF REPORT Final Report		13b. TIME COVERED FROM Summer '94 to Fall '94	14. DATE OF REPORT (Year, Month, Day) December 1995		15. PAGE COUNT 97
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number) Document World War II history of the Ravenna Ordnance Plant		
FIELD	GROUP	SUB-GROUP			
05	06				
19. ABSTRACT (Continue on reverse if necessary and identify by block number) This report presents the results of an examination of historical records related to the construction and operations of the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio. This project was undertaken as part of a larger Legacy Resource Program demonstration project to assist small installations and to aid in the completion of mitigation efforts set up in a 1993 Programmatic Agreement among the Army Materiel Command, the Advisory Council on Historic Preservation, and Multiple State Historic Preservation Officers concerning a program to cease maintenance, excess, and dispose of particular properties. As part of the larger project to develop the national historic context of seven sample installations on a state and local level, the major focus of the project at RVAAP was to document the impacts that the facility had on the state and local environments. The project was conducted by Gray & Pape, Inc., under subcontract to Geo-Marine, Inc., during the summer and early fall of 1994. Duane Peter, Senior Archeologist at Geo-Marine, served as Principal Investigator. Rita Walsh, Historian, at Gray & Pape, conducted the oral history interviews as well as the archival and historic investigations. As one of the Ordnance Department's Government-Owned Contractor-Operated industrial facilities, RVAAP was designed to load, assemble, and pack munitions and materiel for European and American forces during World War II. In addition to explaining technical aspects of the load, assemble, and pack process, this report discusses the direct and indirect effects construction and operations had on the city of Ravenna and the smaller communities of eastern Portage County. The pressures during the boom period of construction, and to a lesser extent during operations, brought hardships to residents and the local governments, yet the economic prosperity that accompanied the increase in population helped dissipate the last vestiges of the Depression. Although many communities near GOCO facilities across the nation faced new economic problems at the end of World War II due to the closure of those facilities and subsequent exodus of workers, eastern Portage County felt slightly less impact because of the U.S. government's continued use of RVAAP and its neighbor, the Portage Ordnance Depot, during the post-war years.					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL Joseph Murphey			22b. TELEPHONE (Include Area Code) 817-885-6386		22c. OFFICE SYMBOL CESWF-PL-Murphey

**THE WORLD WAR II ORDNANCE DEPARTMENT'S
GOVERNMENT-OWNED CONTRACTOR-OPERATED
(GOCO) INDUSTRIAL FACILITIES:**

**RAVENNA ORDNANCE PLANT
HISTORIC INVESTIGATION**

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under
U.S. ARMY CORPS OF ENGINEERS
Fort Worth District
Contract No. DACA63-93-D-0014

U.S. ARMY MATERIEL COMMAND HISTORIC CONTEXT SERIES
REPORT OF INVESTIGATIONS
NUMBER 7A

Geo-Marine, Inc.
550 East 15th Street
Plano, Texas 75074

December 1995

CONTRACT DATA

This document was prepared under Contract No. DACA63-93-D-0014, Delivery Order No. 014 (GMI project # 1114-014), with the U.S. Army Corps of Engineers, Fort Worth District, P.O. Box 17300, Fort Worth, Texas, 76102-0300.

MANAGEMENT SUMMARY

This report presents the results of an examination of historical records related to the construction and operations of the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio. This project was undertaken as part of a larger Legacy Resource Program demonstration project to assist small installations and to aid in the completion of mitigation efforts set up in a 1993 Programmatic Agreement among the Army Materiel Command, the Advisory Council on Historic Preservation, and Multiple State Historic Preservation Officers concerning a program to cease maintenance, excess, and dispose of particular properties. As part of the larger project to develop the national historic context of seven sample installations on a state and local level, the major focus of the project at RVAAP was to document the impacts that the facility had on the state and local environments.

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As one of the Ordnance Department's Government-Owned Contractor-Operated industrial facilities, RVAAP was designed to load, assemble, and pack munitions and materiel for European and American forces during World War II. In addition to explaining technical aspects of the load, assemble, and pack process, this report discusses the direct and indirect effects construction and operations had on the city of Ravenna and the smaller communities of eastern Portage County. The pressures during the boom period of construction, and to a lesser extent during operations, brought hardships to residents and the local governments, yet the economic prosperity that accompanied the increase in population helped dissipate the last vestiges of the Depression. Although many communities near GOCO facilities across the nation faced new economic problems at the end of World War II due to the closure of those facilities and subsequent exodus of workers, eastern Portage County felt slightly less impact because of the U.S. government's continued use of RVAAP and its neighbor, the Portage Ordnance Depot, during the post-war years.

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ACKNOWLEDGMENTS

We would like to express our appreciation to the many individuals who were instrumental in the successful completion of this document. Primary among these are the current personnel of the Ravenna Army Ammunition Plant. In particular, we must single out for recognition James McGee, the Security/Facilities Supervisor, who provided introductions to the interviewees and set up appointments with them; Tim Morgan, the project contact; Bob Kaspers, the Commander's Representative; as well as Karl Urban; John Cicero; Vicki Record; Emma Lamp; Rick Bauman; Lynette Windland; and Frances Scott.

Several people who either worked at the plant during World War II or were residents of the area during that period were interviewed or provided information through personal communications. Among these are Estella Decker, Henry Lock, Robert and Gladys Walters, Peggy Williams, Maurice Paul, and Carl Bauman. These individuals provided invaluable information concerning everyday life at the facility during World War II. This document would be incomplete without their generous contributions.

We would like to thank Joseph Murphey of the U.S. Army Corps of Engineers, Fort Worth District, who was most supportive of our efforts. He provided constructive criticism and management direction throughout this project. In the Geo-Marine, Inc., office in Plano, the final editing and overall production of the report were the responsibilities of Ms. Sharlene Allday. Ms. Sandy Carr provided computer graphics, and Ms. Denise Pemberton generated the computerized format for the layout and design of the book.

CHAPTER 1

INTRODUCTION

This report presents the results of research into the historical record of Ravenna Army Ammunition Plant, Ravenna, Ohio, 1939-1989. The purpose of this report was to partially fulfill the goals of a larger project that entails not only this specific historical investigation, but also a national context for the World War II Ordnance Department's government-owned contractor-operated (GOCO) industrial facilities, 1939-1945 (Kane 1995); detailed investigations into the history of seven former World War II-era Ordnance Department GOCO industrial facilities (present-day Badger, Indiana, Joliet, Kansas, Radford, Ravenna, and Twin Cities army ammunition plants); and photographic documentation of the same sample installations. Goals of the larger project included investigation and documentation of World War II and pre-World War II buildings and structures now under the jurisdiction of Army Materiel Command (AMC) as part of a Legacy Resource demonstration program of assistance to small installations, as well as the completion of mitigation efforts stipulated in a 1993 Programmatic Agreement among the AMC, the Advisory Council on Historic Preservation, and multiple State Historic Preservation Officers concerning a program to cease maintenance, excess, and dispose of particular properties. The detailed historic investigation of Ravenna Army Ammunition Plant, like the detailed historic investigations for the other sample installations, was undertaken in order to develop the national historic context on a state and local level. The major focus is upon the impacts of the facility on state and local history.

In September 1993, Geo-Marine, Inc. (GMI), was contracted by the Army Corps of Engineers, Fort Worth District, to complete the national historic context, detailed historic investigations, and photographic documentation. The research for the Ravenna Army Ammunition Plant detailed historic investigation was conducted by Gray & Pape, Inc., under contract to Geo-Marine, Inc., during the summer and fall of 1994. Duane Peter, Director of the Cultural Resources Division at GMI, served as Principal Investigator. Rita Walsh, Historian at Gray & Pape, Inc., conducted the oral history interviews and the archival and historical investigations and wrote the report. The work was performed under Delivery Order No. 014 of Contract No. DACA63-93-D-0014.

Chapter 2 of this report describes the objectives of and the methods used in the detailed historic investigations. Chapter 3, the historic context portion of this report, is divided into nine basic sections. The first discusses the military/political background of the Ravenna facility. The second provides details of the architectural/engineering design background of the Ravenna plant. In the third section, contractor operations are described. Technology is the focus of the fourth section. The fifth section provides information on social history, and the following sections detail the effects of the end of the war, the post-war years, and the facility's environmental legacy. The final section of Chapter 3 consists of a summary and conclusions. A list of references cited follows the main body of the report.

CHAPTER 2

OBJECTIVES AND METHODS

STATEMENT OF OBJECTIVE

The primary goal of the investigation at Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio, as set forth in the Scope of Work (Murphey 1993:4), was to "provide [an] understanding of the World War II military-industrial complex through detailed examination of the sample installations [Ravenna was one of seven], expanding the national historic context." The focus of the investigation was "on World War II social issues of state and local significance, . . . [including] 1) Controversies over Government acquisition of the land, 2) How the change in the labor base affected of the [*sic*] local areas, 3) Impacts women and blacks had in the local work force, etc." (Murphey 1993:4). These efforts are undertaken to partially fulfill objectives of the overall project, which are to "research and document World War II and earlier buildings and structures at a number of ammunition plants under the jurisdiction of the Army Materiel Command (AMC) as a Legacy Resource Program demonstration project for assistance to small installations" and to "fulfill mitigation efforts of a 1993 Programmatic Agreement among the AMC, the Advisory Council on Historic Preservation, and Multiple Historic State Preservation Officers concerning a program to cease maintenance, excess, and dispose of certain properties" (Murphey 1993:1).

METHODS

The research methodology involved the examination of numerous graphic and written resources that provided both a national overview of the political, social, technological, and architectural context, and more specific information regarding the history of the Ravenna Ordnance Plant (ROP) (presently known as RVAAP) and its effect on the surrounding community. Information on the national context was attained mainly from a variety of books, articles, and reports from the 1940s as well as later scholarly studies that examined many of the facets of this period. Three World War II histories of the plant, including an entertaining account of the plant's erection by the construction contractor, Hunkin-Conkey Construction Company, and a nine-volume history by Atlas Powder Company, the operating contractor, provided much of the information contained in this report. Local research included visits to the Ravenna and Kent public libraries to view newspapers, county histories, and files that had pertinent information about the plant's history and impact.

Personal interviews were conducted in August 1994 with 11 people who either worked at the plant during the World War II era or are currently employed at the Ravenna facility. James McGee, the Security/Facilities Supervisor at the plant, provided introductions to the interviewees. Information of the war production years, based personal experience and memories, were provided by Estella Decker, who worked at the plant and whose

family owned 40 acres of land that was purchased by the government; Henry Lock, who was employed at the plant during both the construction and operational phases; Robert and Gladys Walters, war-time employees; and Peggy Williams, a World War II employee. Ms. Williams worked at the plant only during the war years; the other four interviewees were long-term employees of the plant, during World War II and during the various phases of plant activity and inactivity until the 1980s. Carl Bauman, who is extremely familiar with the technical aspects of shell loading, worked at the facility in the years immediately following World War II and provided the use of a chart illustrating the production totals of the plant during the war effort.

Current plant employees Robert Kaspers, the Commander's Representative; Sue McCauslin, Environmental Specialist, consultant to Mason & Hanger-Silas Mason Co., Inc.; Timothy Morgan, forester at RVAAP; and Karl Urban, Property Administrator, RVAAP, graciously shared their knowledge of the plant and its history. Maurice Paul, the son of one of the original landowners was interviewed by telephone. Robert Walters and Estella Decker possessed many of the copies of the 1940s plant magazines (none remain at the plant) and the original Hunkin-Conkey Construction Company history of the plant's construction. The magazines were graciously lent for reproduction and research purposes, with several photographs from the magazines used in this report.

The Engineering Department vault in the old Administration Building at the plant yielded the original 24-x-36" drawings by Wilbur Watson and Associates; however, most were revised several times between the 1950s and the 1970s, reflecting updated production processes and other less technical changes. The only versions of these original drawings that exist are copies reduced in size to approximately 11-x-17," which are compiled in a ledger book at the plant. These versions were used as the figures in this report. Many of the original specifications books, complete with the addendums so common during the initial design phase, are stored here, as well a small number of building specifications from the Picatinny Arsenal that were used to draw up the specifications for this plant. The drawings produced by the Hunkin-Conkey Construction Company, the Atlas Powder Company, and the Jennings-Lawrence Company, architects of the Portage Ordnance Depot, as well as the architectural drawings from later decades are archived here as well. The vault also contains a small number of aerial and topographic maps from the 1940s and later decades. The only photographs found that date from the 1940s are those pasted into the multivolume historical record inventories which feature exterior views of all buildings, including the 58 farmhouses re-used for housing and other purposes, and one booklet which contains original black-and-white photographs documenting construction from 1941 and 1942. This booklet is designated as Book No. 4 of these construction photographs, but the previous three books were not found.

Historical data were also found in other rooms of the old Administration Building near the Engineering Department vault. These included two manuals titled *Description of Manufacture* prepared by the Picatinny Arsenal in 1944 and 1946 for the load, assembly and pack of the M36A1 primer and the 8-inch M106 shell, unfuzed with supplementary charge, respectively. Newsletters and original black-and-white photographs that date from the 1950s were also discovered in files in another room. It should be noted that only the architectural drawings in the Engineering Department vault are in any kind of order, and no inventory exists for the holdings in this building.

Several scrapbooks that contain newspaper articles from the 1940s and 1950s about the plant and issues related to it are still located at the plant, although in most cases the date and newspaper from which the article came are not noted. These articles were used, however, because while microfilm copies of the area newspapers such as the *Akron Beacon Journal*, the *Cleveland Plain Dealer*, and the *Ravenna-Evening Record* were available, the limited research time did not permit an extensive reading of these resources.

The research effort included not only finding all of the resources used to compile the history of the plant, but ascertaining which information was correct. A great many reports exist that document the plant's early years and were all thoroughly examined. But each presented some important facts which did not agree with the other reports. For instance, three dates are given in three separate documents for such a simple fact as the date of

the government contract with the construction contractor. In these situations, the conflicting dates or numbers are noted in footnotes or within the text.

In conclusion, it must be recognized that the volume and extreme detail of the information contained in all of these resources cannot be included in a report of this size, but must necessarily be summarized with a few examples that illustrate certain points. Fortunately this information is recorded in all of the official histories and reports compiled during the World War II-era and can be found at the National Archives in Washington D.C.

CHAPTER 3

HISTORIC CONTEXT FOR RAVENNA ORDNANCE PLANT, A WORLD WAR II ORDNANCE DEPARTMENT GOGO INDUSTRIAL FACILITY, 1939 - 1989

The Ravenna Ordnance Plant (ROP), today called the Ravenna Army Ammunition Plant (RVAAP), is located in northeastern Ohio primarily in eastern Portage County with a small section reaching into western Trumbull County (Figure 1). The plant's present 21,419 acres include both the original load, assembly, and pack plant built between September 1940 and March 1942 and the adjacent Portage Ordnance Depot, constructed between March 1941 and August 1942 (Anonymous 1943:10-12)¹. The plant and the depot were combined on April 24, 1943, as a single administrative center that was renamed the Ravenna Ordnance Center; it was one of three ordnance works and plants that were consolidated in 1943 (*Ravenna Ordnance Plant [ROP]*, company magazine produced by Atlas Powder Company, article n; Voight 1945:1). The plant contained approximately 650 buildings, not including the many utility structures and houses on the installation, while the depot had over 600 buildings. Although the plant and the depot were joined in 1943 under a single commander, only the ROP will be discussed in detail in this report because only this facility was part of the Industrial Service of the Ordnance Department. The Portage Ordnance Depot was built under the Field Service Permanent "A" Depot program of 1941 (Murphey 1993:4).

The ROP was the first load, assembly, and pack (LAP) facility authorized to be constructed by the government, and the contracts were awarded to the contractor operator, architect-engineer, and construction contractor in late August 1940. The contractor operator was the Atlas Powder Company of Wilmington, Delaware, who was also contracted for "[m]anagement services in planning, designing and organizing the Ravenna Plant for operation" for which they received a lump-sum fixed fee (Atlas Powder Company [APC] 1943b:1). Wilbur Watson and Associates of Cleveland was the architect-engineer firm for the project, and Hunkin-Conkey Construction Company, also of Cleveland, served as the construction contractor.

Situated approximately 10 miles west of the county seat of Ravenna, the plant is located in a relatively level area that encompasses parts of Paris, Charles, Windham, and Freedom townships. Over 1,000 acres of the plant are located in Trumbull County, the county to the east. The area, devoted to agricultural pursuits before the plant was constructed, has a serene rural setting despite some nearby new house construction along Route

¹ In the 1943 Completion Report prepared by the U.S. Army Corps of Engineers, the total acreage comprising the Ravenna Ordnance Plant was placed at 14,626.74, of which 13,221.45 acres were situated in Portage County and 1,405.29 acres in neighboring Trumbull County to the east (War Department 1943:2).

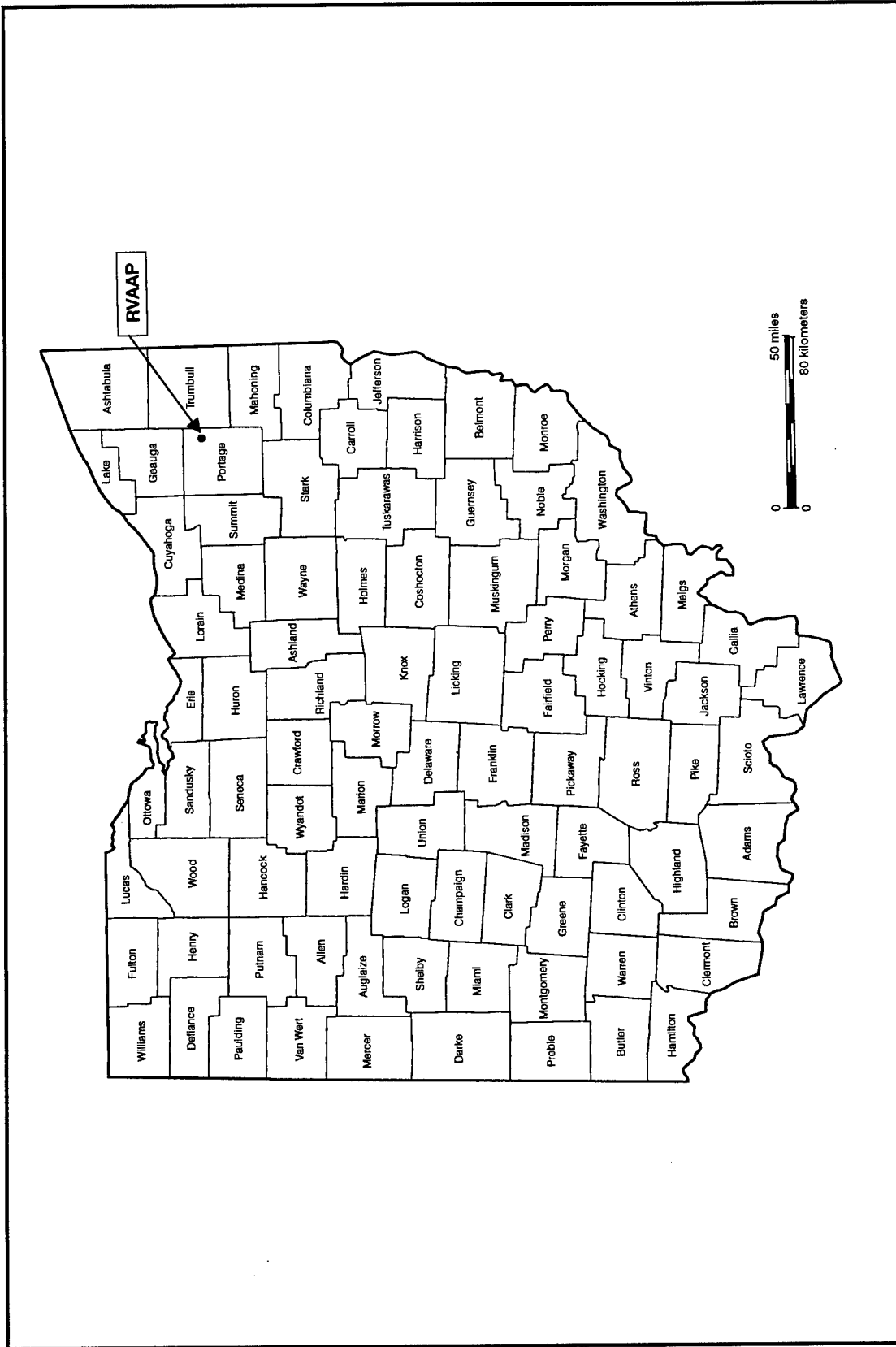


Figure 1. Location of the Ravenna Ordnance Plant (Ravenna Army Ammunition Plant) in eastern Portage County, Ohio.

5 on the south side of the plant and the busy nature of the two-lane Route 5, which carries a high volume of traffic. The boundaries of the plant extended to Route 5 on the south, the right-of-way of the Erie Railroad on the north, the former Route 80 or Greenleaf Road on the west (which borders the former Portage Ordnance Depot), and State Route 534 in Trumbull County on the east. The small towns of Windham and Newton Falls lie in close proximity to the north and to the east, respectively.

The 1945 Ordnance Facilities Inventory states that in 1945 the installation covered 18,685 acres in Paris, Windham, Charlestown, and Freedom townships. It further states that the original installation occupied approximately 24,000 acres but several parcels were turned back over to the Army Corps of Engineers for disposition (Voight 1945:3). The Atlas Powder Company history reports that "the original property comprised 17,000 acres more or less. Later, approximately 238 acres south of the southeast corner were purchased in order to secure access to the West Branch of the Mahoning River. Still later approximately 1,405 acres were purchased in Trumbull County. The above property does not include that purchased by the Field Service Branch for the Portage Ordnance Depot" (APC 1943b:7).

The ROP was originally intended to contain three bomb and shell loading lines; two fuze lines; two booster lines and a plant for the production of ammonium nitrate for making amatol, a substitute for TNT in the early years of World War II; and storage facilities for inert materials and finished products. Numerous support buildings included eight boiler houses, administration buildings including a large hospital, single-family staff houses, two sewage plants, guard and fire houses, and dormitories. A detonator, artillery primer, and percussion element line were soon added, as well as a fourth load line, more warehouses, and an additional ammonium nitrate plant. By March 1942, when the contractor operator took over all of the buildings for production, the plant contained 12 load lines, "forty explosives igloos, forty bomb igloos, eighty shell igloos, seventeen magazines for holding shells in suspense, twenty-one smokeless powder magazines, twenty-three fuze and booster magazines, seventy explosives magazines, six igloos for lead azide, tetryl and fulminate of mercury (two each), thirty-six inert storage warehouses, and 113 miles of railroad" (Voight 1945:3) (Figure 2).

The combined acreage of the plant and depot was nearly two-thirds the size of the nearby city of Akron at that time and was in many aspects a self-sustaining city (Anonymous, Scrapbook article ss). In addition to the load lines, the plant contained "water works (2), sewage disposal and drainage, steam generating plants, outside steam, air and electric lines, plant transportation, material storage and magazines, plant maintenance, service and control laboratories, communications system, guard system, fire protection and plant safety, a hospital and first aid stations, ground, erosion control, etc., laundry, print shop, service garage, commissary, dwellings and dormitories, recreation center, and administration buildings" (APC 1943b:53). In fact, the plant's location was christened Apco, Ohio (an acronym for Atlas Powder Company), during World War II because it had a federal post office and a railroad passenger station (Morgan, interview 1994) (Tables 1-6).

All but one of the lines are of permanent construction with steel superstructures, concrete foundations, corrugated asbestos roofs, and brick or tile walls, or as in the case of the storage igloos, reinforced concrete exteriors. The three load lines (the detonator, percussion element, and artillery primer lines) added to the Atlas contract in February 1941 were also of permanent construction (APC 1943b:3). The later supplements to the contract, dated June 1941 to December 11, 1941, included the buildings of Load Line IV and 24 inert storage warehouses, specified to be of temporary construction with wood frames and asbestos wall coverings (APC 1943b:3).

Many of the buildings throughout the plant exhibit a remarkable similarity to one another, seen in their gable roofs covered with corrugated asbestos and topped with ridge ventilators, tile and/or brick side walls, and steel superstructures. Most buildings have single or double leaf doors and multipaned steel sash awning windows. Most are one-story in height, except for the three-story melt-load buildings on the four load lines. An adherence to functionality as opposed to architectural statements for the sake of appearance was the overriding design concept; the only buildings that exhibit a recognizable style are the Administration Area buildings and the staff houses in that area, which are simple renditions of the Colonial Revival. The 12 load line buildings and the Administration Area lie in the southern section of the plant, while the seven storage groups are located

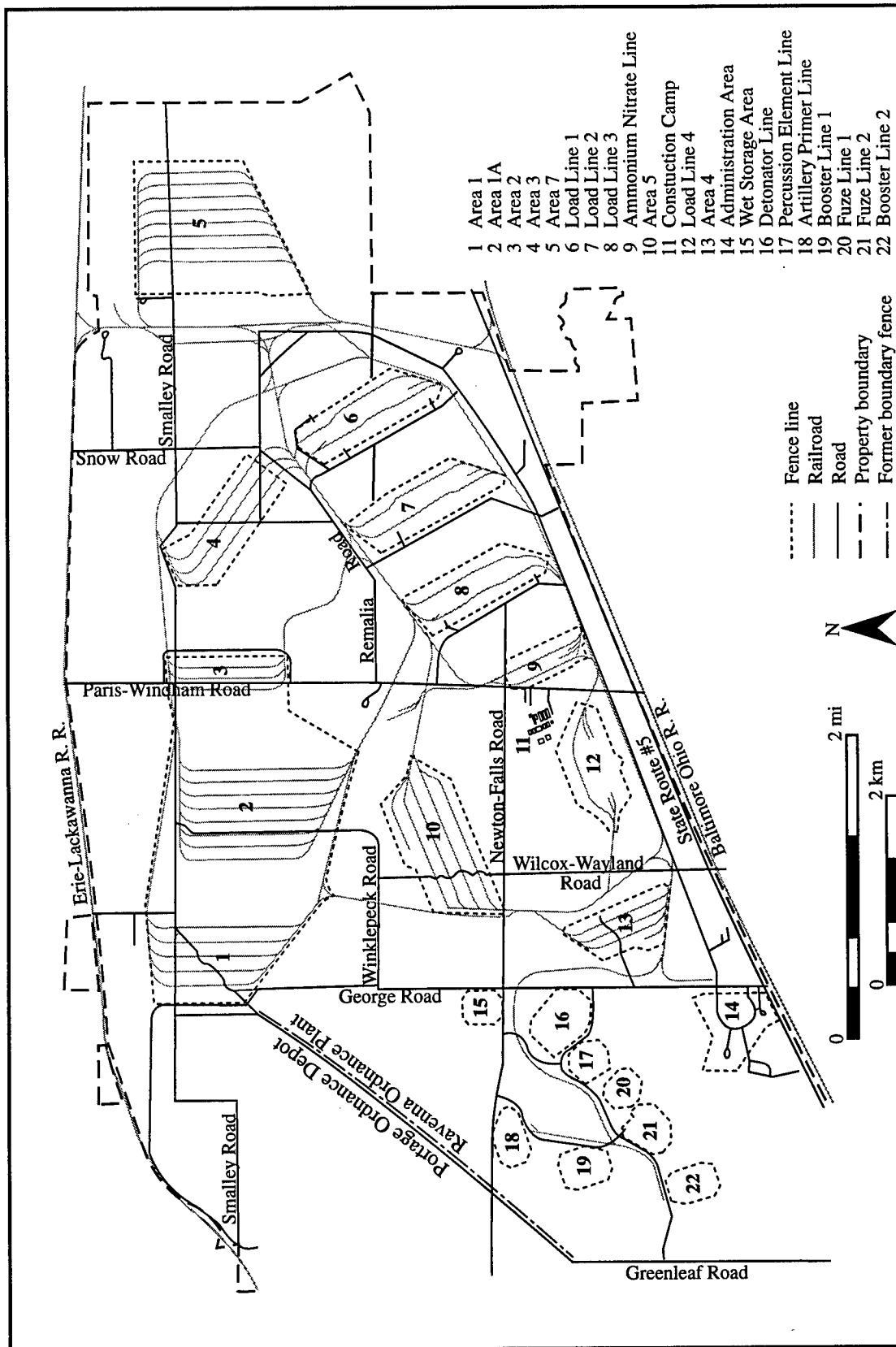


Figure 2. Installation map of Ravena Ordnance Plant from World War II.

Table 1
Number of Buildings by Area at the Ravenna Ordnance Plant in 1943
(Does not include utility buildings and dormitories)

Load Line/Area	Number of Buildings (Principal Type)
Melt Load Line 1	26
Melt Load Line 2	22
Melt Load Line 3	21
Melt Load Line 4	22
Fuze Line No. 1	20
Fuze Line No. 2	26
Booster Line No. 1	19
Booster Line No. 2	18
Detonator Line	34
Artillery Primer Line	17
Percussion Element Line	26
Ammonium Nitrate Line No. 1	8
Ammonium Nitrate Line No. 2	9
Inert Storage Warehouses	37
Smokeless Powder Magazines	26
Fuze and Booster Magazines	26
Ammunition Magazines	17
High Explosives Storage Igloos	106
Ammunition Storage Igloos	80
Bomb Storage Igloos	44
Administration Buildings	23
Staff Residences	15

Source: War Department 1943:2

to the north, with the exception of the Fuze and Booster Storage area, which lies in the southern half next to the Fuze and Booster Area (Figure 3). The official cost for construction of the plant came to \$61,469,239 (Voight 1945:1). A cost of \$77 million was attributed to the plant in a 1993 report, which ranks Ravenna as the tenth most expensive Government-Owned Contractor-Operated (GOCO) plant in the country (Murphey 1993:Appendix I:6).

The World War II mission of the Ravenna plant was to load, assemble, and pack ammunitions of 75-mm, 76-mm, 155-mm, 240-mm, 6-inch, and 8-inch sizes; bombs of 100-pound, 500-pound, 1000-pound, and 2000-pound sizes; and munition components consisting of fuzes, boosters, detonators, artillery primers, and percussion elements. Additionally, the plant was involved in the production of ammonium nitrate, production

Table 2
Administration Buildings at the Ravenna Ordnance Plant in 1944

Type of Building/Structure	Type of Construction	Number
Administration Building	Wood	1
Telephone Building	Brick and concrete	1
Employment Office	Wood	1
Cafeteria	Wood and steel	1
Outside Labor Building	Steel and brick	1
Hospital	Wood	1
Dormitory and School Building	Wood and masonry	1
Outside Labor Building	Steel and brick	1
Guard House and Office	Wood	1
Guard House and Office	Wood	1
Laboratory	Wood and brick	1
Nurses Home	Wood (one of remodeled farmhouses)	1
Print Shop	Wood	1
Guard House Garage	Steel and brick	1
Fire House and Quarters	Wood	1
Gasoline Service Pump House	Brick	1
Staff Quarters (8 rooms)	Wood	8
Staff Quarters (7 rooms)	Wood	7
Fire Station	Brick, wood and concrete	2

Source: War Department 1944

of metal components for detonators and primers, and screening and renovation of ammunition received from outside sources (Voight 1945:1). The Portage Ordnance Depot's mission was the storage of classes one to ten ammunition, which included the finished products of the ROP (Anonymous 1943:11).

As the first plant to load shells in the country, the output of the Ravenna plant from August 18, 1941, to August 15, 1945, included the production of 75-mm shells (24,416,749) of 10 different types on Load Line I; 19,270,797 fuzes on the two fuze lines, which included renovation and salvage; and 79,580,576 detonators, relays, and booster caps produced on the Detonator Line (APC 1945b). These numbers represent only a small percentage of the types of ammunition and the production numbers output at the Ravenna plant during this four-year period.

The Atlas Powder Company received orders from the War Department to cease operations on August 15, 1945 (APC 1945a:IX:17) and the contract was terminated on November 24, 1945 (Voight 1945:2). Immediately after the war, the main activity of the plant was the reception of surplus ammunition from overseas for storage, renovation, or disposal under the Operation Standby plan. The disposal or demilitarization of ammunition mainly consisted of detonation during this time (MacDonald and Mack Partnership [MacDonald and Mack] 1984:41). From late 1946 until early 1950, the Silas Mason Company of Shreveport, Louisiana, took over the old Ammonium Nitrate line for the manufacturing of ammonium nitrate grade fertilizer that was shipped to Europe under the Marshall Plan (MacDonald and Mack 1984:41).

Table 3
Load Line Buildings at the Ravenna Ordnance Plant in 1944

Type of Building/Structure	Type of Construction	LL I	LL II	LL III	LL IV
Melt-Pour Building	Steel and tile	2	2	2	1 ¹
Inert Storage Building	Steel and brick	1	1	1	
Drilling & Boosting Building	Steel and tile	1	1	1	
Paint & Oil Storage & Mixing Bldg.	Steel and tile	1	1	1	1 ²
Receiving and Painting Building	Steel, concrete and tile	1	1	1	
Ammonium Nitrate Service Building	Steel and tile	1	1	1	
High Explosive Prep. Building	Steel, concrete and tile	1	1	1	
TNT Service Building	Steel and tile	1	1	1	1 ³
Change House	Steel, concrete and tile	5	3	3	
Booster Service Building	Steel and tile	1	2	2	
Fuze Service Building	Steel and tile	1	1	1	
Assembling and Shipping Building	Steel, concrete and tile	1	1	1	1 ²
Primer Service Building	Steel and tile	1			
Smokeless Powder Service Building	Steel, concrete and fill	1			
Electric Locomotive Service Building	Steel and tile	1	1	1	
Line Office Building	Reinforced concrete and brick	1	1	1	1 ²
TNT Box Building	Steel and tile	1	1	1	
X-Ray Building	Wood and concrete		1		
Time Clock Alley	Steel and brick	1	1	1	1 ⁴
Shell Sectionalizing Building	Reinforced concrete				
Inert Storage and Truck Repair	Wood and sheet asbestos				2
Service Buildings	Wood and sheet asbestos				8
Boiler House	Wood and asbestos-covered metal				1
Ammonium Nitrate Screening Building	Wood and sheet asbestos				1
Cooling Building	Wood and sheet asphalt				1
Top Pour Building	Wood and sheet asbestos				1
TNT Screening Building	Wood and sheet asbestos				1

¹ Wood, concrete and tile

² Wood and sheet asbestos

³ Concrete, wood and sheet asbestos

⁴ Wood and asbestos shingle

Source: War Department 1944

Beginning in 1951, Ravenna Arsenal, Inc., another contractor, took over the loading of shells and anti-tank mines during the Korean Conflict. Ravenna Arsenal, Inc., a subsidiary of Firestone Tire and Rubber Company, was the operator until 1957 when the plant closed its loading operations (MacDonald and Mack 1984:43-44). During the Vietnam War period, the plant's functions were the renovation of equipment from other plants and, beginning in 1968, the production of shells, cartridges and two kinds of primers (MacDonald and Mack 1984:46).

The plant was returned to standby status in 1971, though some renovation and demolition operations continued until 1984 (MacDonald and Mack 1984:46). In 1983, the operation of the plant was sold by Firestone to Physics International Company, a subsidiary of Rockcor, Inc., of Seattle, Washington, and Olin

Table 4
Fuze and Booster Area Buildings at the Ravenna Ordnance Plant in 1944

Type of Building/Structure	Type of Construction	F1	F2	B1	B2	AP	DT	PE
Fulminate Dry House Building	Wood			1	1			1
Fulminate Mix House	Steel, tile and concrete	1	1				2	
Primer Loading Building	Steel and tile		1	1				
Black Powder Dry House Building	Brick, wood and tile	1	1			1		
Black Powder Pelleting Building	Concrete, steel and tile	1	1					
Delay Loading Building	Steel and tile	1	1					
Primer Dry House	Steel and tile	1	1					
Fuze Assembly Building	Steel and tile	1	1					
Fuze Testing Building	Concrete and tile	1	2	1	1	1	2	1
Change House	Steel and tile	2	3	2	2			
Inert Storage Building	Steel and tile		1	1	1	1	1	1
Shipping Building	Steel and tile		1	1	1	1	1	1
M-103 Delay Loading Building	Steel and tile		1					
Time Clock Alleys	Steel and brick	1	1	1	1	1	1	1
Tetryl Screening & Blending Bldg.	Concrete and tile			1	1			
Tetryl Pelleting Building	Concrete and tile			1	1		1	
Booster Assembling & Shipping	Steel and tile			1	2			
Tetryl Pellet Storage Building	Brick and tile			1	1			
Tetryl Cupping Building	Steel and tile			1	1			
Barrel Test Building	Steel and tile			1				
Heater House	Wood			2	2		10	6
Dry House - Azide	Wood						3	
Screen House	Wood						1	
Final Inspection, packing & ship	Steel, brick and tile						1	
Detonator Rumbling Building	Concrete and tile						1	
M22-Booster Detonator Assembling	Concrete, brick and tile						1	
M22-Charge House	Wood						1	
Detonator Test	Steel, brick and tile						1	
Detonator Loading Building	Steel and tile						3	
Compulsory Shower change house	Steel and tile						1	
Change House	Steel and tile					1?	2	1
Detonator Destroying House	Wood							1
Control House	Brick and tile						1	1
Dining Building	Concrete masonry and wood					1	1	
Percussion Element Building	Steel, brick and tile							1
Ice House	Wood							1
Preliminary Dry House	Concrete and tile							3
Canned Primer Storage	Concrete and tile							2
Final Dry House	Reinf. Concrete and tile							1
Testing, Packing & Shipping	Steel and tile							1
Potassium Chlorate-Sieving and Weighing House	Concrete and tile							2
Wet Mix Building	Concrete and tile							1
Mixture Inspection Building	Concrete and tile							1
Gum Solution Preparation Bldg.	Concrete and tile							1
Primer Canning Building	Brick and tile							2
P.E.T.N. Screen House	Wood							1
P.E.T.N. Dry House	Wood							1
Napkin Preparation Building	Wood							1
Black Powder Screening Building	Concrete and tile					2		
Fan House	Concrete, steel and tile					1		
Artillery Primer Loading Building	Steel, concrete and tile					1		
Primer Rest House	Reinf. concrete and tile					1		
Primer Preparation Building	Brick and tile					1		
Black Powder Storage	Steel and tile					1		
Artillery Primer Test Building	Tile					1		

Source: War Department 1944

Table 5
Ammonium Nitrate Line Buildings at the Ravenna Ordnance Plant in 1944

Type of Building/Structure	Type of Construction	Number
Neutral Liquor Storage Building	Steel and brick	1
Neutral Liquor Storage Building	Brick and wood	1
Change House	Steel, concrete and tile	1
Lunch room	Wood and asbestos shingles	1
Office Building	Brick	1
Evaporating & Crystallizing Units	Steel and tile	7
Time Clock Alley	Steel and brick	1
Boiler House	Steel and brick	1

Source: War Department 1944

Table 6
Storage Facilities at the Ravenna Ordnance Plant in 1944

Type of Building/Structure	Type of Construction	Number
Area 1 - Type 1, Bomb Storage Magazines	Reinforced concrete	40
Area 1A - Ammunition Storage Magazine	Reinforced concrete	80
Area 2 - Ammunition Storage Magazine, Type 2	Steel and tile	17
Area 3 - Smokeless Powder Magazine, Above Ground	Steel and Tile	21
Area 4 - Standard Magazine for Fuze and Booster Storage	Brick, steel and tile	26
Area 5 - High Explosive Storage Igloo, underground	Reinforced concrete	44
Area 6 - Inert Storage Building	Steel and brick	8
LCL Inert Storage Warehouse	Steel and brick	1
Change house	Steel and tile	1
Area 7 - High Explosive Storage Igloo, underground	Reinforced concrete	66
Area 8 - Inert Storage Warehouse	Wood and sheet asbestos	24
Wet Storage Area		
Underground Storage Magazine - Fulminate	Reinforced concrete	2
Underground Storage Magazine - Azide	Reinforced concrete	2
Underground Storage Magazine - Tetryl	Reinforced concrete	2

Source: War Department 1944

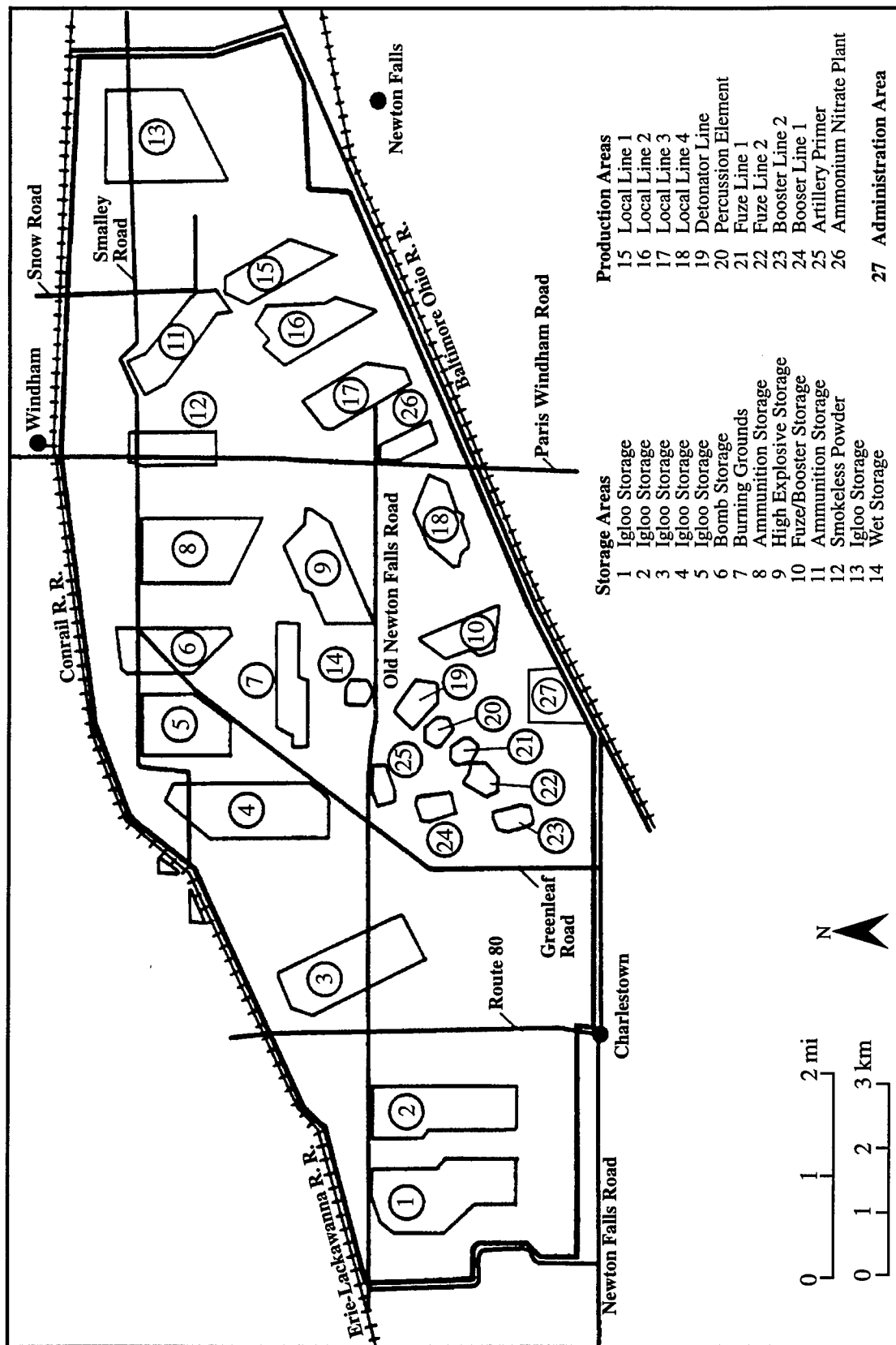


Figure 3. Map showing a more recent depiction of the layout of the Ravenna Army Ammunition Plant (after Stafford et al., 1984).

Corporation (MacDonald and Mack 1984:47; USAAMCC 1989:4). In 1993, the company of Mason & Hanger-Silas Mason Company, Inc., was awarded the Modified Caretaker Contract (McGee, interview 1994). The plant's mission at the present time is the storage and maintenance of explosive material and other industrial stock (Kaspers, interview 1994).

The numerous technical advances in bomb and shell loading, along with the enormous output of high-quality ammunition, were the leading contributions of the ROP during World War II. The plant's importance is also evident in the monumental construction effort accomplished in one and one-half years: the extensive number of people, amounts of materials, and months of 24-hour construction "days" which made the ROP the most important enterprise in Portage County history. The plant's economic and social impacts have continued to the present day, providing employment to three generations of Portage County residents. The plant's current status is a concern of many Portage County residents (and their political representatives) who either mourn its loss of vitality or who see the future possibilities of the site in other, more labor-intensive and profitable functions.

MILITARY/POLITICAL

Planning the GOCO Ordnance Plant/Ordnance Works System

The national historic context, *Historic Context for the World War II Ordnance Department's Government Owned Contractor Operated Industrial Facilities, 1939-1989* (Kane 1995), provides a more detailed explanation of the events and policies that shaped the planning effort and the resultant GOCO Ordnance Plant/Ordnance Works System. A brief summary discussion of the major events is presented for this study.

The confused and wasteful experience of the mobilization effort during World War I taught the military that planning, particularly for priorities and balanced production, was key to a successful procurement program. Although the country was intensely isolationist after World War I, planning efforts were begun in a small way soon after the war. These efforts grew with the increasing military tensions in the 1930s and the increased military budgets that corresponded to the tensions.

The Interwar Years: Procurement Planning (1918-1941)

The planning effort for procurement began just after World War I. The ill-planned experience during that war convinced military planners that planning was essential for well-organized and rapid preparations for war in the future. One of the first measures was Congressional approval of the National Defense Act of 1920, which among other purposes, delineated responsibility for procurement planning through the Assistant Secretary of War. In 1922, 13 Ordnance Districts were established throughout the country, which played a key role in procurement planning and the GOCO industrial facilities program during the war. The government's six arsenals were also extremely important in the planning efforts because of their individual specializations in the manufacture of a particular kind of materiel and the fact that these arsenals were the storehouses for detailed information on these manufacturing processes.

During the years between the wars, the Ordnance Districts kept in contact with private industry regarding the availability of existing facilities for war-time conversion, machine tool surveys, and the placement of Accepted Schedules of Production with private manufacturers. The Accepted Schedules of Production were agreements that listed the amounts of materiel that would be produced if war occurred. The arsenals developed plans and layouts for implementation of the manufacturing processes by private industry, which were later used as the preferred models for the GOCO industrial plants. The Picatinny Arsenal in Dover, New Jersey, was the center for layouts and specifications for all of the GOCO LAP facilities.

U.S. Gears Up for War

Armament planning was regarded as a necessity not only because of the past experience during World War I, but because there were strong signs that war could become a reality in the near future. During the 1930s, increasing military tensions abroad caused the military appropriation budget to rise; between 1934 and 1935 the budget rose from \$7,048,455 to \$11,049,829. In 1938, Germany's further aggressions caused an increased level of funding by Congress that allowed planning funds for LAP facilities, small arms ammunition, and equipment for powder. In this same year, educational orders were authorized to be placed with private industries for certain materiel in short supply or that were difficult to manufacture. These educational orders were changed to defense contracts in 1940 after Germany invaded France. Production studies, which involved contracts to private companies for the determination of equipment and methods for mass production of ordnance items, were another means of planning.

The placement of overseas orders aided the U.S. in its build-up for war despite neutrality laws. In 1938, European countries began to order supplies from the U.S. through a loophole in the legislation that allowed these governments to obtain the supplies through the payment of cash and delivery on their own ships; battle supplies, however, were exempted from this policy. With the invasion of Poland and other Eastern European countries in 1939, Britain and France declared war on Germany. The neutrality legislation was changed then to allow foreign countries to buy surplus U.S. materiel.

Just before France fell to the Germans on May 27, 1940, President Roosevelt declared a state of limited national emergency. From this time until December 1941, Congress voted to fund the Ordnance Department's budget many times over the 1920 appropriation. This period became the crucial 18 months that military planners theorized was the minimum time needed to prepare for war. The first national defense appropriation act was passed in June 1940. In that same month Congress passed supplemental acts that included funds for the construction of GOCO facilities. The first contract for a GOCO facility was signed in July 1940 with E. I. du Pont de Nemours & Company for a smokeless powder plant in southern Indiana. The LAP facility at Ravenna, a propellant and explosives plant in Radford, Virginia, and a tank arsenal in Detroit were the next three contracts, all signed in August 1940. The headline announcing the construction of the Ravenna plant in the local newspaper was paired with one that reported the Nazis bombing of the outskirts of London, which underscored the urgent need for these plants (*Evening Record/Daily Courier-Tribune [ER]* 1940a).

Planning for the Installation

The locations of the GOCO plants were determined by several primary factors that were mainly related to the geographical and industrial characteristics of the vicinity. These factors included the necessity of existing railroad lines near the plant location for shipping purposes, level but relatively inexpensive land, an inland location more than 200 miles within the country's borders to minimize the possibility of enemy attack by air, a large available labor and materials pool, remoteness from large centers of population due to the potentially hazardous character of the operations, and the proximity of other war materiel production plants. An additional, though unstated, factor involved the degree of political influence that motivated the choice for a particular location.

Ohio was the location for five of the 77 GOCO facilities, just behind Texas (with seven), and Indiana and Illinois (with six plants each) (Kane 1995:2). The other GOCO plants in the state were the Plum Brook Ordnance Works in Sandusky on Lake Erie; the Scioto Ordnance Plant in Marion, north of Columbus in the center of the state; Kings Mill Ordnance Plant, Warren County, north of Cincinnati, in the southwest portion of the state; and the Buckeye Ordnance Works at South Point, in south-central Ohio, just north of Huntington, West Virginia. Although a sixth GOCO industrial facility, the Ohio Gun Plant, was planned and constructed for the proposed production of gun tubes, production goals for gun tubes were lowered in

1942 and their manufacture was never initiated at the facility. Instead, the installation was transferred to the Field Service and was operated for the duration of the war as the Lima Tank Depot (Kane 1995:21).

The ROP's proposed location about 10 miles east of the county seat of Ravenna on the eastern edge of Portage County admirably fit the selection criteria. Its most attractive feature was the presence of two railroad lines, the Baltimore & Ohio (B & O) and the Erie Railroad, which ran nearly parallel east-west courses divided by a five-mile strip of level land. A third railroad, the Pennsylvania Railroad, was also available for shipping raw materials and finished products as they had track rights over the B & O lines. Adding a connection between the Erie and B & O lines within the plant presented a "decided advantage" (APC 1943b:8).

The more than 17,000 (see footnote ¹) acres purchased in the townships of Paris, Charlestown, Freedom, and Windham were mainly agricultural, level land with only the small towns of Windham, Paris, and Newton Falls nearby. Although the land proved to be very swampy and rocky in some places, which created some serious construction problems, it was also very wooded, which provided a good cover for the plant's various lines, a situation that has been maintained to the present time. The plant's location midway between the industrial communities of Akron and Youngstown assured access to the immense pools of industrial labor that would be required. Ravenna itself possessed several small industries, and its growth prior to August 1940 was described as "unspectacular but steady" (Works Progress Administration [WPA] 1940:415). During the war years, however, the northeastern area of Ohio became one of the leading centers of war-time production activity, which contributed to the labor shortages experienced at the plant in the later years of the war.

The choice of the Portage County location seems to have also been a matter of political influence. It appears that its selection was favored by the expressed donation of the eastern portion of the 1,300-acre Bolton farm, located on the western edge of the proposed plant's acreage (Lock, interview 1994; McGee, interview 1994). The Bolton Farm was owned by Mrs. Frances Bolton, a member of the U.S. House of Representatives from 1940-1967, whose deceased husband, Chester Castle Bolton, had been the U.S. Representative from 1929-1937. Mrs. Bolton, in 1955, became the first female member of Congress to head a U.S. mission abroad (MacDonald and Mack 1984:58). Ultimately, all of the farm was acquired by the government although most of it was within the borders of the Portage Ordnance Depot, which lay just west of the plant. It is rumored that while Mrs. Bolton's initial offer was a donation, the remainder was sold to the government at a hefty price (Lock, interview 1994). Early newspaper articles also mentioned the involvement of Democratic representative Dow Harter from Akron in the Ravenna site selection, but the exact nature of his role and that of Mrs. Bolton's remains uncertain. The details of the negotiation stage and the political weight of certain individuals is recommended for further study.

On August 26, 1940, the Atlas Powder Company entered into a contract (W-ORD-463) with the United States Government. Under Title I of this contract, the Atlas Powder Company received a lump-sum fixed fee for management services in planning, designing, and organizing the ROP for operation; under Title II, the Atlas Powder Company, as an independent contractor, operated the Plant and received operating costs plus a fixed fee (APC 1943b:1). A few days later, on August 30, 1940, the architectural-engineering firm and the construction contractor signed their contracts (APC 1943b:1). The date of August 28, 1940, however, is given for these contracts in other sources, which is the same day the notices were sent from the government to the property owners notifying them of the acceptance of their option agreements (McDowell 1941:16; War Department 1943:4) (Plate 1).

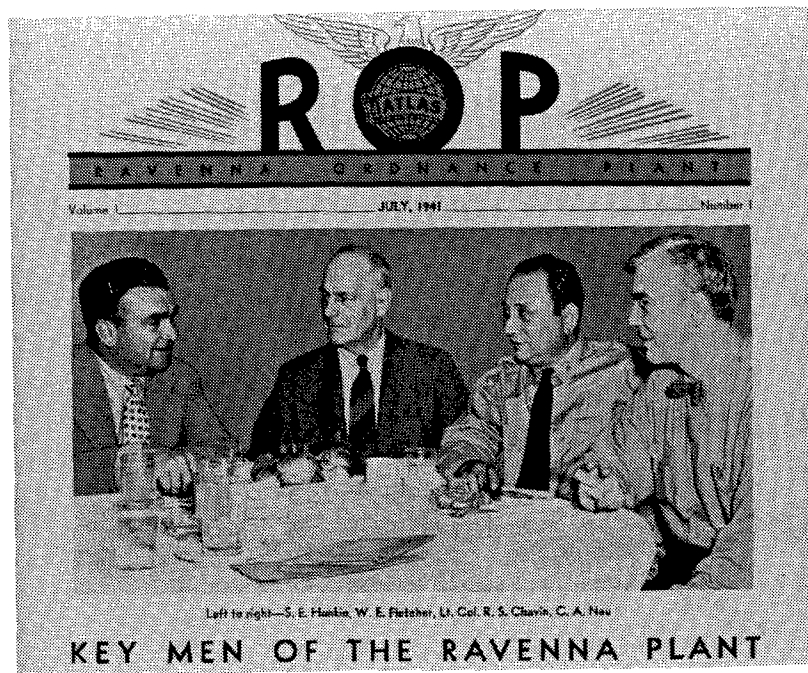


Plate 1. Inaugural issue of the ROP Magazine from July 1941 which featured a cover article on the four key men involved in the building of the Ravenna Ordnance Plant. Left to right: Samuel E. Hunkin, Vice-President, the Hunkin-Conkey Construction Company; W.E. Fletcher, General Manager, The Atlas Powder Company; Lt. Colonel Raphael S. Chavin, Commanding Officer of the Ravenna Ordnance Plant; Carl A. Nau, Principal, Wilbur Watson and Associates (*ROP* article b).

ARCHITECTURAL-ENGINEERING DESIGN

Architectural-Engineering Firm

The architectural-engineering firm hired to design and prepare the drawings and specifications for the ROP was the firm of Wilbur Watson and Associates. The Cleveland firm signed a cost plus fixed fee contract (W6934-QM-1) in late August 1940 (War Department 1943:4). Founded in 1907 as Wilbur Watson and Company, the firm was at first primarily an engineering firm. After 1924 the firm took on building projects of a more architectural nature after architect Carl A. Nau joined the other two partners, Wilbur J. Watson, Doctor of Engineering, and Ralph L. Harding, Civil Engineer. The firm designed both architectural and engineering projects including bridges, docks, hangars and stadia, storage plants, and railroad, college and municipal facilities (McDowell 1941:21). Specific projects included the Firestone Tire and Rubber Company Building in Akron, the World's Fair exhibit for Firestone, and B. F. Goodrich Company, the Goodyear Air Ship dock, and the Talon, Inc., slide fastener plant in Meadville, Pennsylvania. Other clients included the White Motor Company, the Ohio Oil Company, and Industrial Rayon Corporation (*ROP*, article b). The specific circumstances as to how the firm was chosen are not known; it is likely that their prominence in architectural-engineering projects in northeastern Ohio and their proximity to the project aided in their selection. Carl A. Nau was the firm's representative at Ravenna during the design phase.

Although the firm was employed at the plant until November 1942, they were not solely responsible for the design and preparation of drawings for buildings within the plant (War Department 1943:5). Atlas prepared many of the engineering drawings for the equipment layouts in the buildings after extensive study at the Picatinny and Frankford arsenals and at their own plants, and were solely responsible for these arrangements in the Artillery Primer, Detonator, and Percussion Element lines (APC 1943b:55). After the buildings were turned over to Atlas, that company also prepared many drawings for changes to many of the buildings, caused by a number of factors which are discussed below. The Hunkin-Conkey Construction Company prepared drawings for many of the buildings within the temporary Construction Camp.

Drawings for other facilities prepared by other firms include the adjacent Portage Ordnance Depot by the Columbus, Ohio, architectural-engineering firm of Jennings-Lawrence Company (McDowell 1941:112), and the W. B. Gibson Company of nearby Warren, Ohio, which was awarded Job No. M-1 (Contract W 2133-eng-146) for the drawings and construction of the 52-bed T-dormitory in the Administration Area (War Department 1943:5). All drawings prepared by these firms are filed in the Engineering Vault of the Administration Building at the plant.

Architectural-Engineering Firm Design for the Plant

The design for the plant closely followed the specifications, drawings, and standards provided by the Picatinny Arsenal in New Jersey, the government arsenal responsible for the development of plans for LAP facilities (Kane 1995:7). The design of the ROP resulted from the joint participation of the War Department, Atlas Powder Company, and Wilbur Watson and Associates. The Ordnance Department stipulated "insofar as is practicable" that the plant conform to their plans which would be transmitted to Atlas for study and finally given to the architect-engineer for the preparation of the actual plans (APC 1944:2). Although drawings from the Picatinny Arsenal were not available for examination, a comparison of their set of specifications for the melt-pour buildings on the load lines with those produced by Wilbur Watson and Associates reveals an almost word-for-word adaptation of the arsenal's requirements.

The buildings at the plant are of both permanent construction and temporary construction. The former type was defined by its steel framework, concrete foundations, and tile or brick walls. Eleven of the lines, including the ammonium nitrate line, are of permanent construction. Only Load Line IV, authorized for construction in June 1941, and 24 of the inert storage warehouses are of temporary construction, which required the use of wood framing members and sheet asbestos walls. The nickname "Charlie McCarthy" was applied to the wooden Load Line IV by the construction workers (McDowell 1941:149) (Plates 2 and 3). The Administration Area buildings were built mainly of frame construction, to comply with the Ordnance Department's directives (APC 1943b:25).

Although the functions of the buildings were very specialized, the exteriors of the permanent construction buildings are remarkably similar in appearance, particularly in the Fuze and Booster areas. The buildings were mainly one-story in height with two or three bay end walls and rectangular or square plans on concrete foundations. The structures were covered by a gable roof with ridge ventilators, tile walls with brick piers or corners (in some cases, with multipane industrial sash awning windows or wood double-hung windows), and single or double leaf doors with panes of glass in the upper half. The lengths and heights of the buildings were the main differences in appearances (Plates 4-8 and Figures 4-9). During construction the similarity of the buildings, differentiated only by size, caused an extreme state of confusion for the workers, who, subsequently, learned to recognize the buildings by their large numbered signs (McDowell 1941:100). An identical building type was used for many of the buildings which served several of the lines, such as change houses and small service buildings (see Figure 9).



Plate 2. Ca. 1942 photograph of Melt Pour Building G-8 on Load Line IV, completed April 11, 1942 (U.S. Government n.d.).

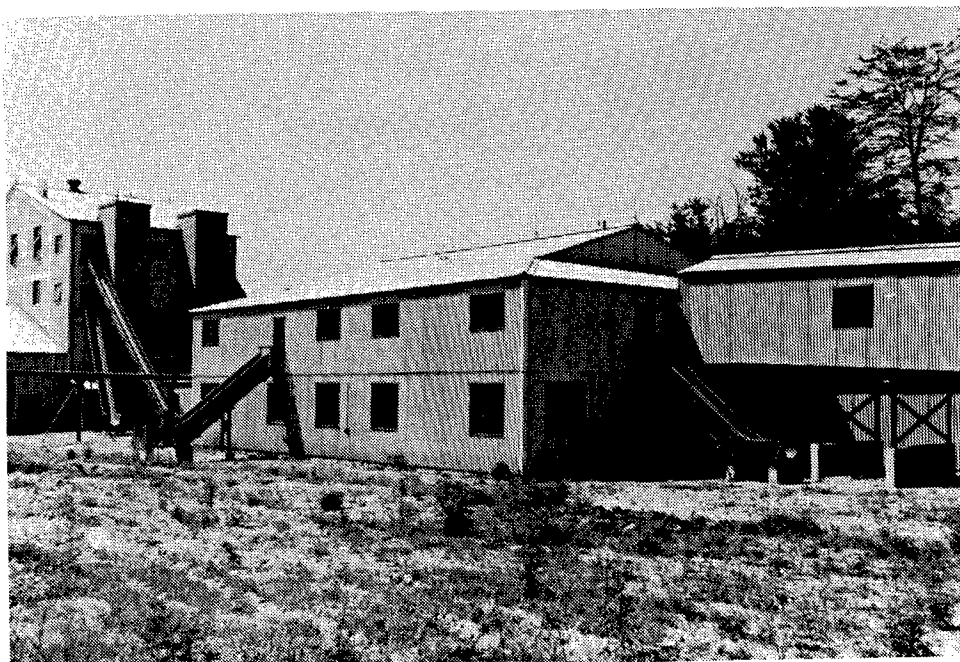


Plate 3. Ca. 1942 photograph of Ammonium Nitrate Building G-10 on Load Line IV, completed April 11, 1942, one of the buildings of temporary construction at the plant (U.S. Government n.d.).

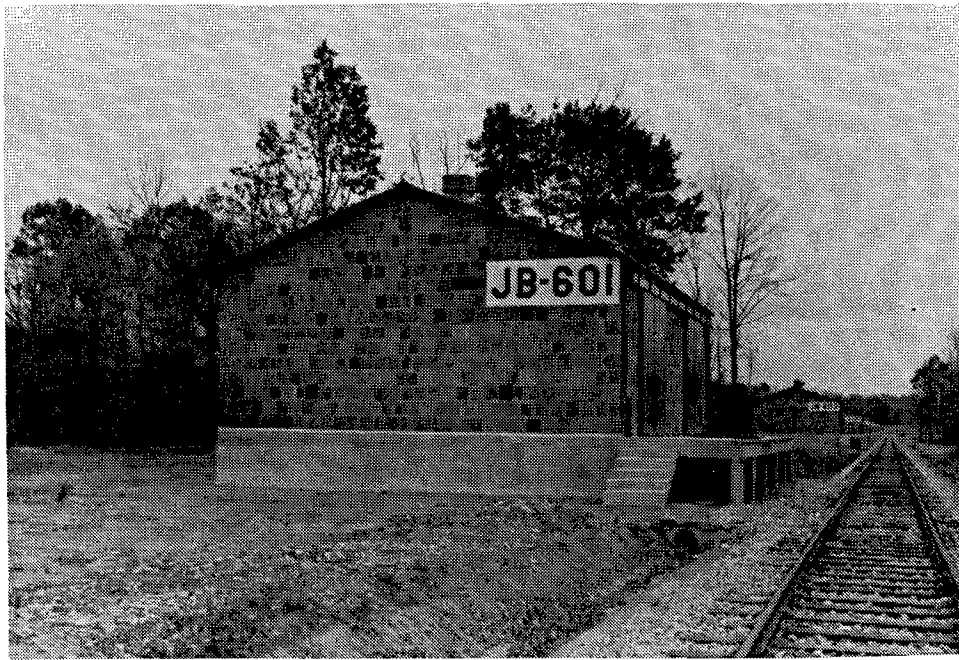


Plate 4. Ca. 1942 photograph of Type 4, Fuze and Booster Storage Magazine JB-601, Group 4 Storage Area, completed August 18, 1941 (U.S. Government n.d.).



Plate 5. Ca. 1942 photograph of Primer Rest House A-9 on the Artillery Primer Line, Fuze and Booster Area, completed March 15, 1942 (U.S. Government n.d.).



Plate 6. Ca. 1942 photograph of Change House DB-WP-22 in Load Line II, completed November 3, 1941 (U.S. Government n.d.).

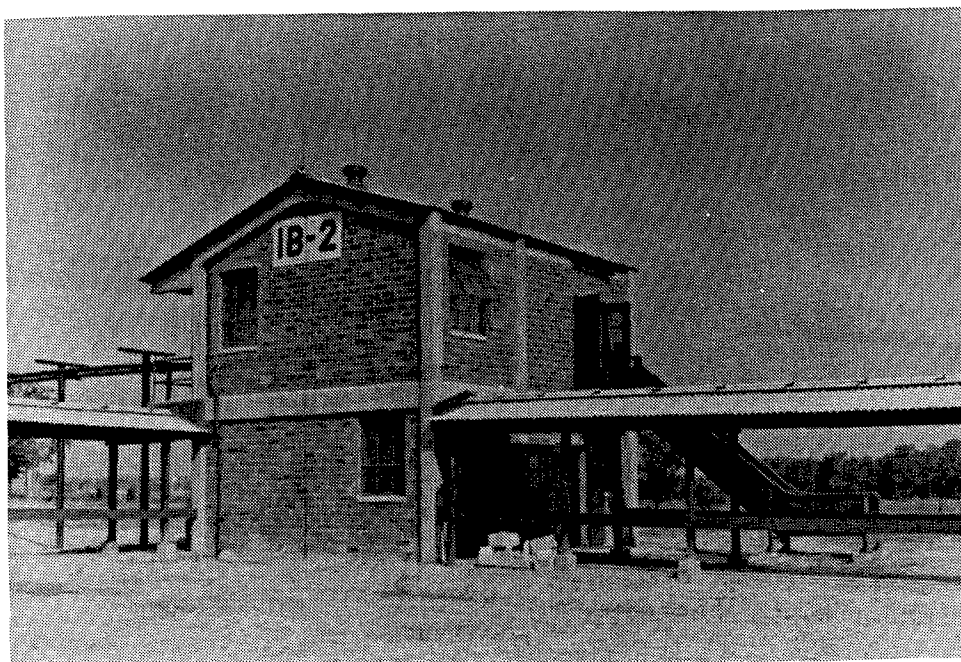


Plate 7. Ca. 1942 photograph of Tetryl Screening and Blending Building 1B-WP2, Booster Line #1, Fuze and Booster Area, completed March 15, 1942 (U.S. Government n.d.).

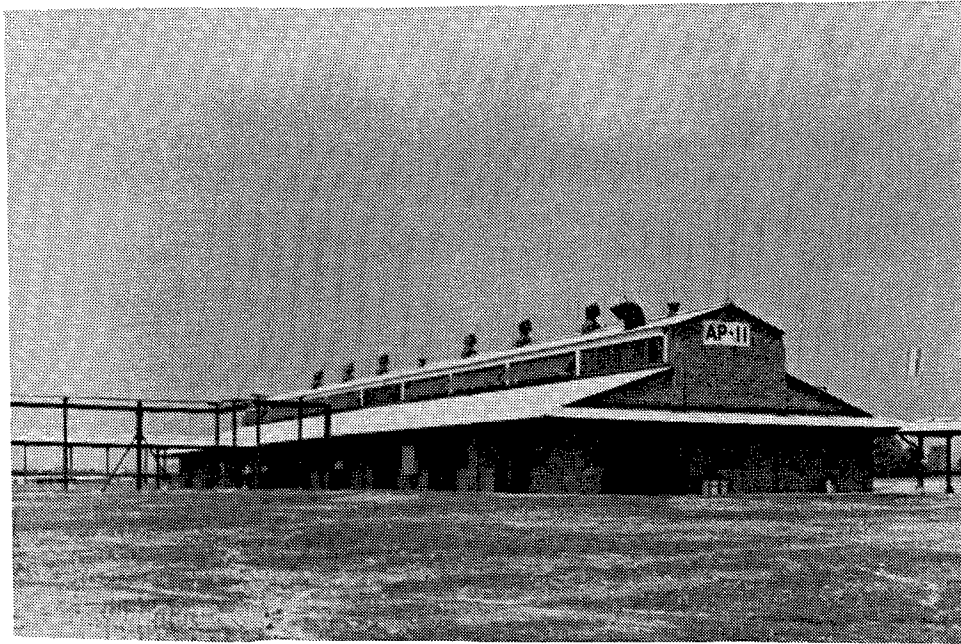


Plate 8. Ca. 1942 photograph of Primer Preparation Building A-11, Artillery Primer Line, Fuze and Booster Area, completed March 15, 1942 (U.S. Government n.d.).

Safety considerations also influenced the design of many of the buildings. Several structures, particularly in the Fuze and Booster area, had interior concrete barrier walls that rose above the roofline to enclose certain hazardous operations that were conducted by remote control (Plate 9 and Figure 10). Some also had rubber flooring to prevent the possibility of electric sparks. Brittleness, not strength, was the desired quality of the side walls of many buildings; therefore, tile walls were used which would blow out more easily in case of explosion and could be rebuilt more quickly upon the steel framework.

The most specialized type of building in the plant, and the type about which the public was most curious, were the storage igloos (Plate 10 and Figure 11). This type, developed by the War Department, was composed "essentially of a reinforced concrete arch, a heavy front and back reinforced concrete wall, and a reinforced concrete floor" (APC 1943b:19). Only a single steel door was located in the front wall of the building. The arch and back wall were mounded with earth and seeded to serve as a barricade and to provide a measure of natural cover from aerial views (APC 1943b:19).

The dictation of such strict standards for the industrial buildings left little room for architectural statements, given the scarcity of time (75 designers and draftsmen worked day and night on the drawings) and the engineering emphasis of the buildings (McDowell 1941:48). The buildings that were not industrial in nature, particularly in the Administration Area, exhibited elements of the popular Colonial Revival style. Though following the tenets of mass production and standardization of materials and floor plans, the 15 staff houses in the Administration Area present the image of a typical cul-de-sac suburb from the period (Plate 11).

It was agreed soon after the contracts were signed that Atlas Powder Company would provide the basic layouts using the typical designs proscribed by the Ordnance Department, and the architectural-engineering firm would perform the survey work (APC 1943b:5). The preliminary layout of the plant was made by Atlas engineers, and was based primarily on the Ordnance Department's requirements for the plant, the existing

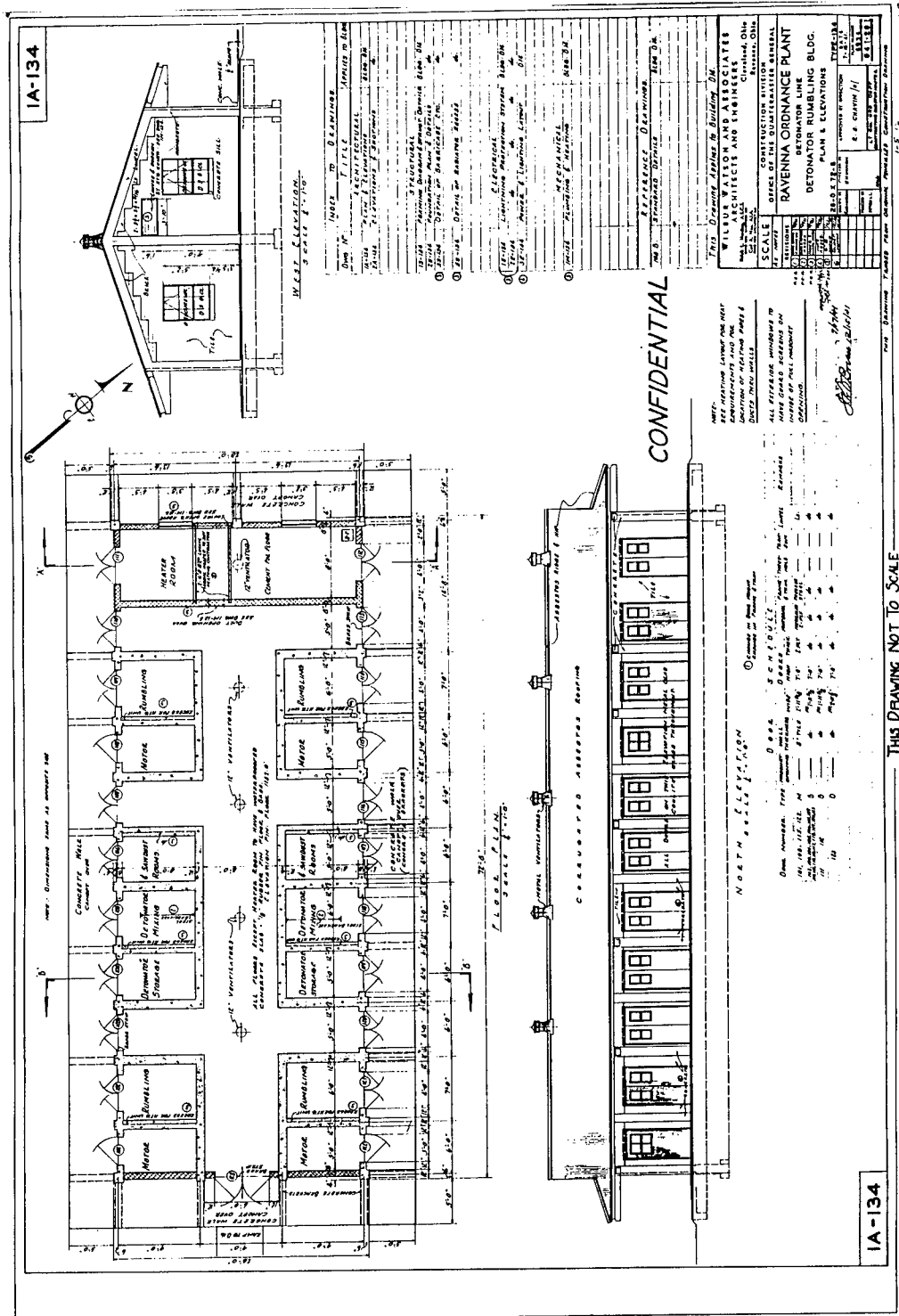


Figure 4. Plans and elevations for Detonator Rumbling Building, dated 7-16-41, Wilbur Watson and Associates, Architects and Engineers, Cleveland, Ohio, Drawing No. 1A-134 (641.201).

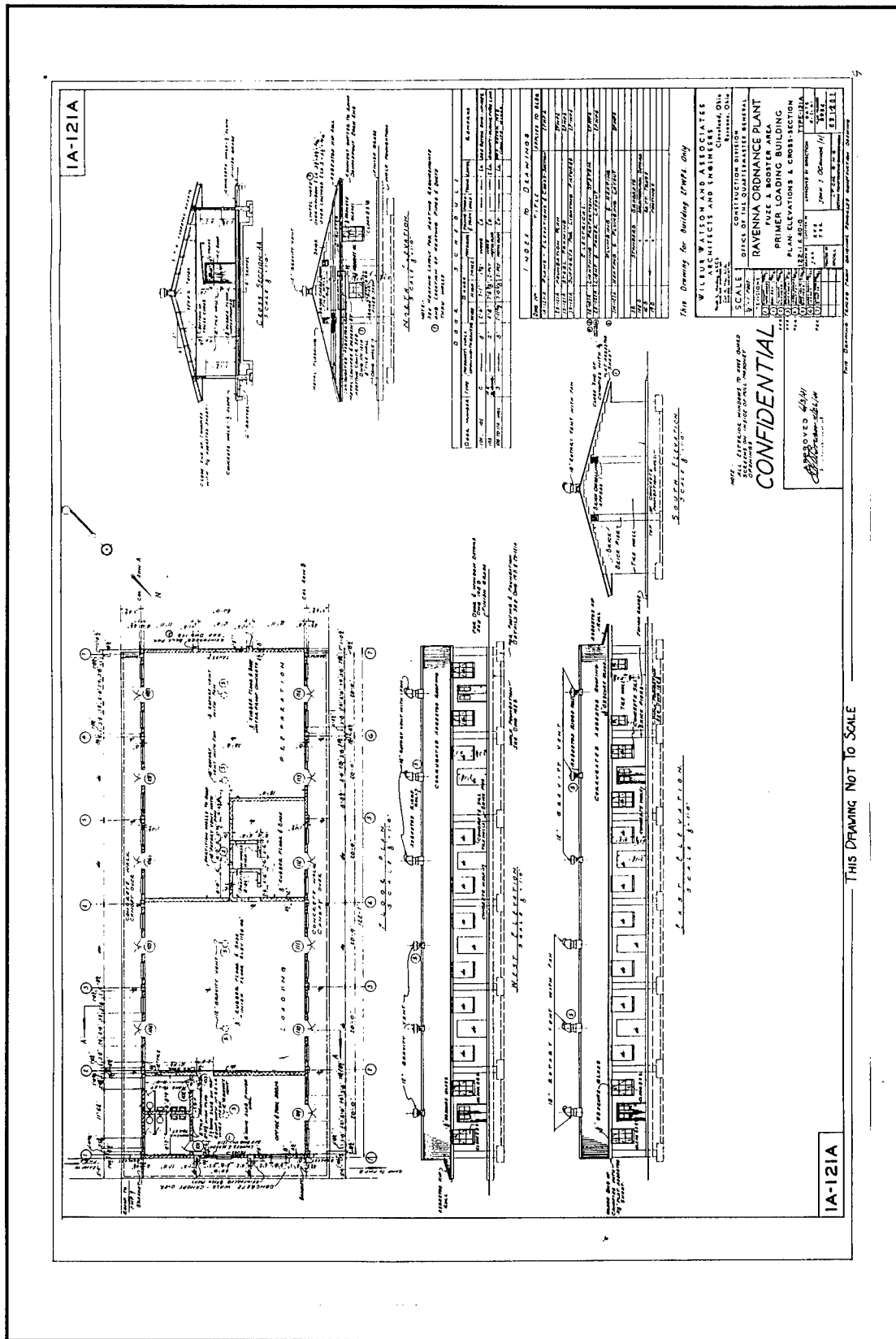


Figure 5. Plans, elevations, and cross section for Primer Loading Building, Fuze and Booster Area, dated 6-2-41, Wilbur Watson and Associates, Architects and Engineers, Cleveland, Ohio, Drawing No. 1A-121A (631.201).

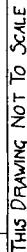


Figure 6. Plans, elevations, sections, and details for Inert Storage Building, Fuze and Booster Area, dated 6-18-41, Wilbur Watson and Associates, Architects and Engineers, Cleveland, Ohio, Drawing No. 1A-123 (633.201).

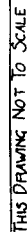
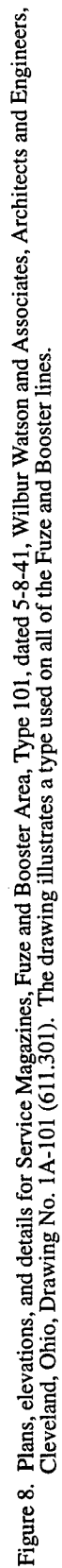


Figure 7. Plans, elevations, and cross section for Tetra Capping Building, Fuze and Booster Area, dated 6-16-41, Wilbur Watson and Associates, Architects and Engineers, Cleveland, Ohio, Drawing No. 1A-152 (657.201).



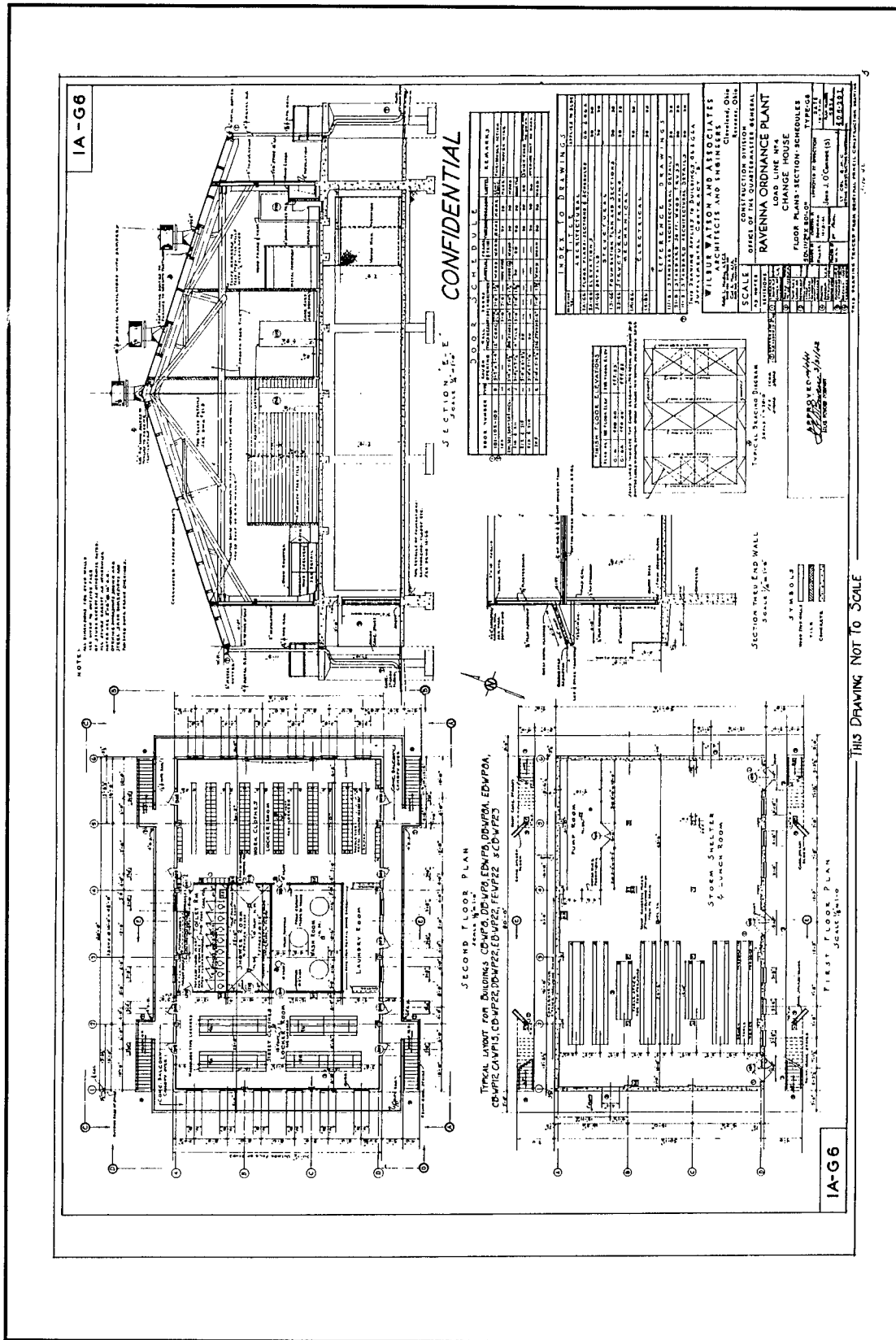


Figure 9. Floor plans, section, and schedules for Change House, Load Line IV, dated 6-16-41, Wilbur Watson and Associates, Architects and Engineers, Cleveland, Ohio, Drawing No. 1A-G6 (406.201). The drawing shows the typical layout for change houses on all of the melt load lines and the ammonium nitrate line.

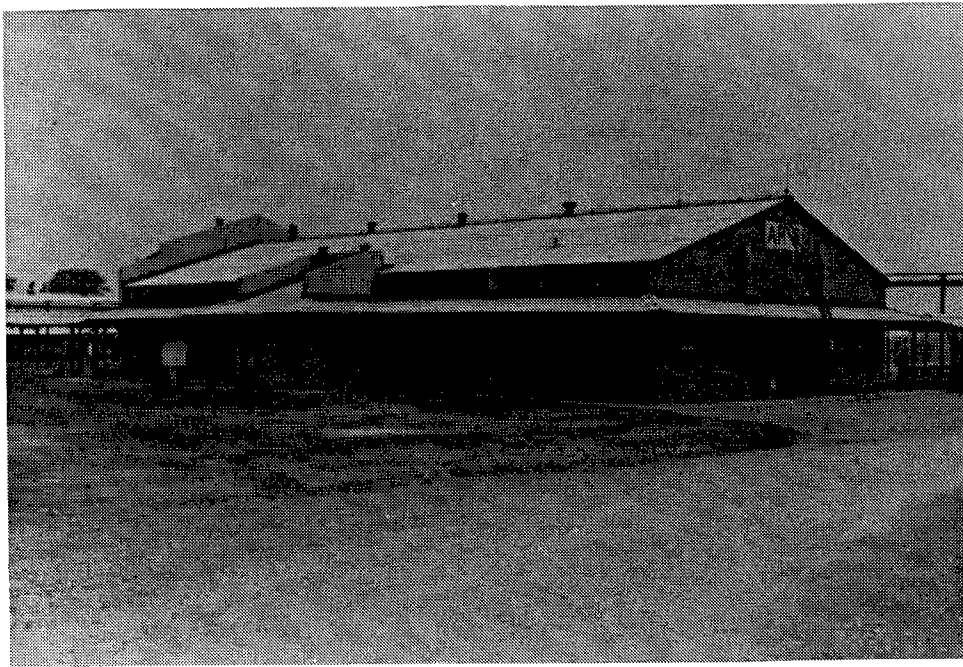


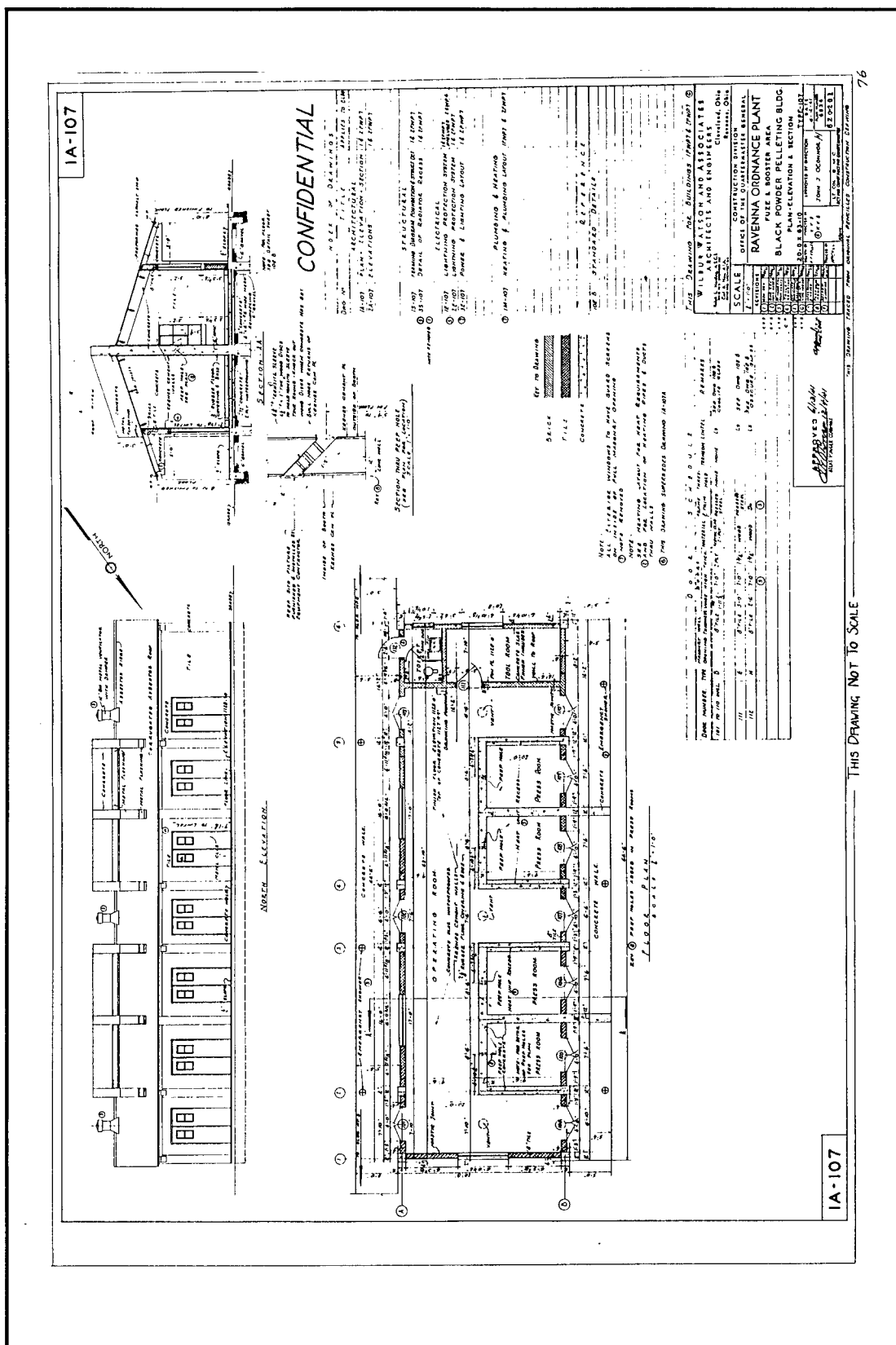
Plate 9. Ca. 1942 photograph of Artillery Primer Loading Building A-8, Artillery Primer Line, Fuze and Booster Area, completed March 15, 1942 (U.S. Government n.d.).

railroad layout, and topographic conditions (APC 1943b:8). The final layout closely followed this preliminary plan, with only a few minor changes in the orientation of the Fuze and Booster loading lines, its storage area, and the smokeless powder magazines (APC 1943b:10). The locations of the lines and their individual buildings were based primarily on safety quantity distance requirements, defined by the Ordnance Department as the proscribed distance between each building and the boundary lines of the facility that, if one were to explode, would prevent further explosions (Plate 12) and the accessibility of the various storage areas and the necessary railroad connections to the lines.

Throughout the design period, the process of laying out the lines was a three-tiered effort that involved the Ordnance Department, Atlas Powder Company, and the architectural-engineering firm. The general requirements for the lines, including typical line layouts, needed utilities, and the individual building layouts and arrangements, were provided to Atlas by the Ordnance Department for study and adaptation using the quantity-distance tables established by the Ordnance Department's Safety Manual. The plans were then transmitted to the architectural-engineering firm to be laid out in the field "under the supervision and subject to the approval of the Atlas Powder Company" (APC 1943b:11).

The level topography was well-suited for the use of railroad lines as the primary mode of transportation within the plant (APC 1943b:8). It was initially considered that the rail transport would be more economical than the alternative, which consisted of using trucks, because the farm roads within the plant were, not surprisingly, inadequate for the required traffic of an industrial plant. Although those that were retained were eventually completely rebuilt and widened (APC 1943b:11), "the idea of building temporary roads into the groups . . . [was] . . . discarded as a waste of time and money" (McDowell 1941:42).

The railroad layout and, therefore, the general location of each line was the first task at hand. The construction crews needed the railroads operative as quickly as possible so that construction could begin, because concrete would have to be delivered to the sites by rail. Therefore, due to the urgent need for the



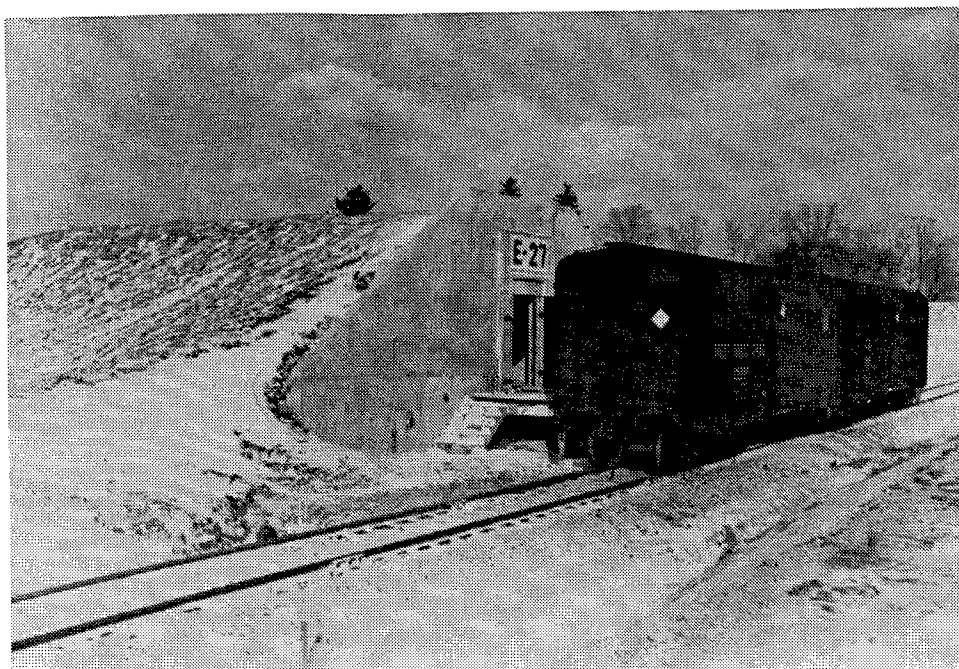
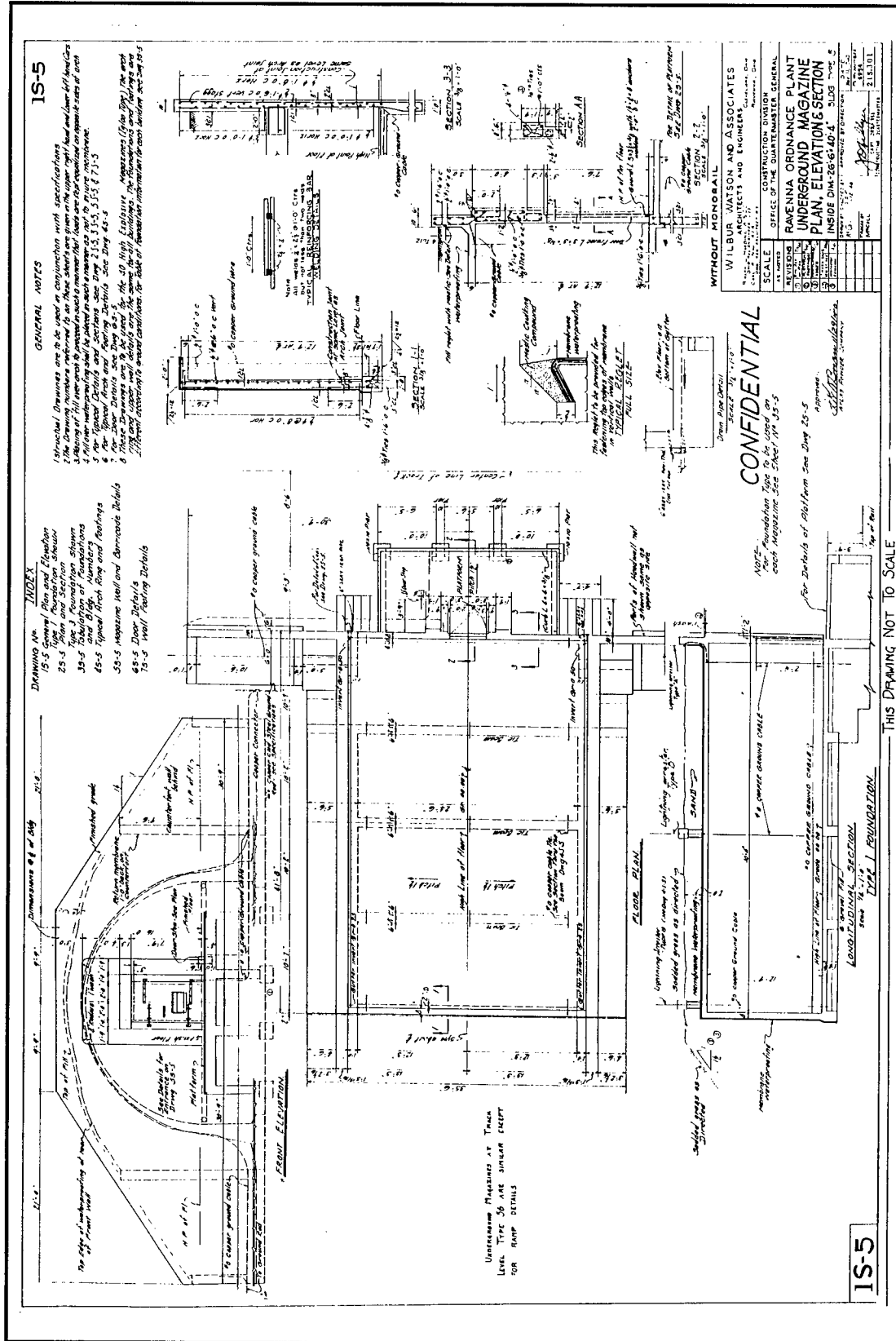


Plate 10. Ca. 1942 photograph of Type 1, Below Ground Bomb Storage Magazine E-27, Group 1 Storage Area, completed December 1, 1941. Commonly known as an igloo, this bomb storage type was developed to control fluctuating temperatures so that ammunition could be stored indefinitely (U.S. Government n.d.).

tracks, the architectural-engineering firm supplied the railroad layouts in a progressive plan rather than as a complete layout (McDowell 1941:74). The railroad mileage within the plan varies by report; however, the construction history reported 130 miles of railroad tracks (McDowell 1941:168).

The layout of the lines was considerably aided by the Erie and B & O railroads (War Department 1943:13). The railroad system in the plant consisted of three main track lines: one to transport inert materials, one to transport explosives to storage and to the shell load lines (as well as the finished products to storage), and one from the finished products storage to the Classifications Yards located at the east end of the plant where a "Y" connection was made between the Erie and B & O railroads (APC 1943b:29). Connected to these main lines were the tracks that ran the full length of the three original load lines as well as to the Ammonium Nitrate plant, to the Inert Storage area, and to the explosive, ammunition, and bomb storage areas (APC 1943b:29). The tracks were kept as level as possible throughout the load lines to prevent the possibility of runaway cars carrying explosive materials (APC 1943b:29) (Plate 13). The mode of transport among the buildings of Load Lines I through III was by a monorail system enclosed in a covered ramp configuration. The Fuze and Booster area had one track that serviced the seven lines pertaining to that area; transport among the buildings of these lines was through the use of covered ramps that connected them (APC 1943b:19, 29) (Plates 14 and 15). All 163 tracks in the plant were interconnected so that traffic could be diverted when necessary (APC 1943b:30; McDowell 1941:74) and the railroad lines in each operating and storage area had two exits (APC 1943b:9).

Experience in construction, however, proved that some roads were necessary (APC 1943b:275). Many of the existing farm roads were rebuilt to withstand the load limits of the traffic during construction and operation. Two roads were added during construction: the south service road, which paralleled State Route 5 and served as one of the main routes for construction traffic, and the road in the Fuze and Booster area (APC 1943b:31).



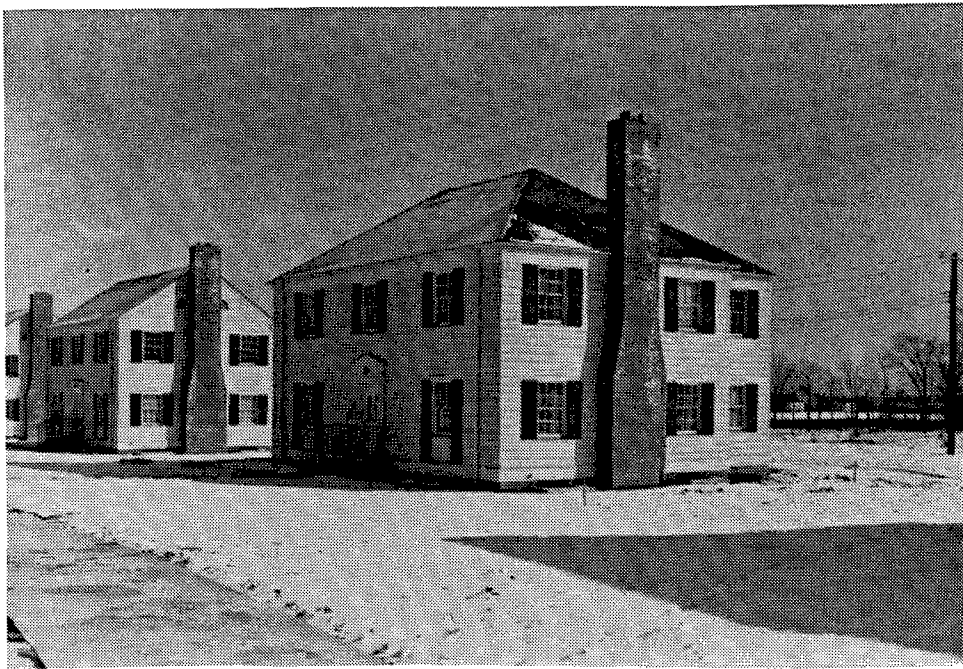


Plate 11. Ca. 1942 photograph of Colonial Revival Staff House 106-F and similar adjacent houses in the Administration Area of the Ravenna Ordnance Plant, completed in March 1942 (U.S. Government n.d.).



Plate 12. Ca. 1942 photograph of Type 2, Above Ground Ammunition Storage AC-165, Group 2 Storage Area, completed August 18, 1941. The plate illustrates the safety distances between storage buildings and their sole accessibility by railroad line (U.S. Government n.d.).

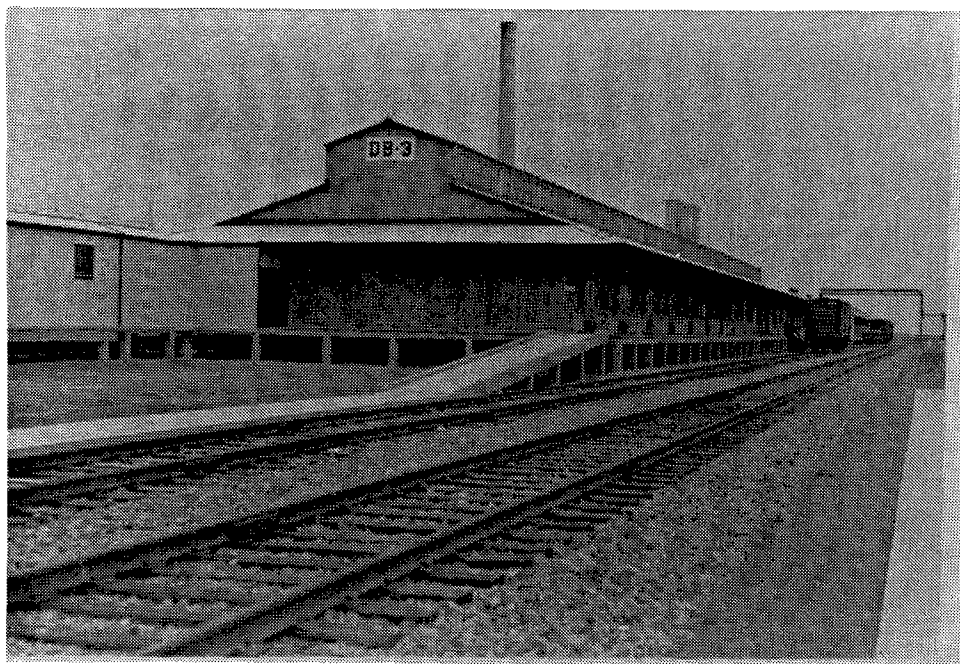


Plate 13. Ca. 1942 photograph of Receiving and Painting Building BD-WP-3A in Load Line II, completed November 3, 1941. Photograph shows the ramps and adjacent railroad line used for transporting and shipping (U.S. Government n.d.).



Plate 14. Ca. 1942 photograph of Tetryl Pelleting Building 1B-WP44, Booster Line #1, Fuze and Booster Area, completed March 15, 1942. The plate illustrates the extensive covered walkway system in the Fuze and Booster area (U.S. Government n.d.).

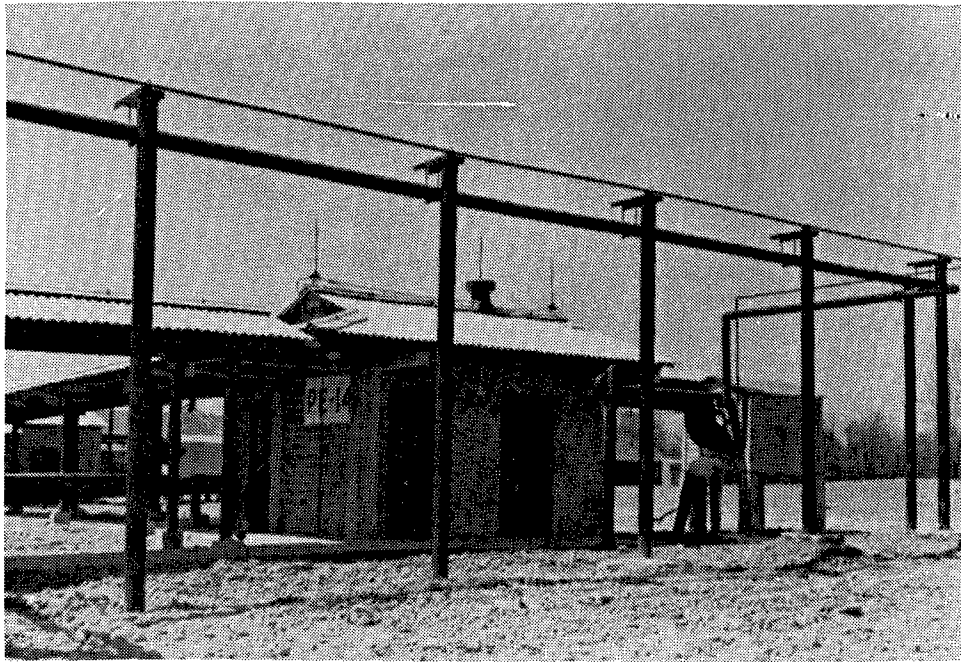


Plate 15. Ca. 1942 photograph of Wet Mix Building P-14, Percussion Element Line, Fuze and Booster Area, completed March 15, 1942. Plate shows the covered walkways and above ground steam lines (U.S. Government n.d.).

Although Atlas and the War Department were primarily responsible for the layouts, one of the most ingenious approaches regarding line layout was developed by Wilbur Watson and Associates. The placement of the bomb and shell load lines was across the contours rather than parallel with them to obtain as much natural protection as possible (APC 1943b:9). While it meant more excavation of ditches in order to achieve the necessary level grade required for the safe operation of these lines, its advantages were readily seen by both the construction contractor and the operating contractor (APC 1943b:9; McDowell 1941:67).

The three original load lines were laid out parallel to each other in the southwest corner of the plant. Parallel to these lines on the west was the Ammonium Nitrate plant with connections for supplying ammonium nitrate at both ends of each of the load lines (APC 1943b:9). The Fuze and Booster area, located west of these lines, was well-separated from these lines and the finished ammunition storage (APC 1943b:9). The storage of high explosives was in the center of the plant, farthest away from the boundary lines and accessible to all shell loading lines (APC 1943b:9). The Administration Area was placed in a location in the southern half of the plant, easily accessible to Route 5 near one of the main roads in the plant but far enough away from the other plant activities to meet distance safety requirements (APC 1943b:25). Above ground steam lines were built throughout the plant, a usual practice in bomb-loading plants (APC 1943b:10) (Plate 16). Wooded areas around the lines were retained as much as possible to provide natural cover for the buildings, a policy directed by both the War Department and Atlas (APC 1943b:42) (Plate 17).

The pronounced functionality of the plant's layout and buildings is the most noteworthy aspect of its design. The Atlas report mentioned the development of steel bin barricades at this plant, in anticipation of barricades being required for igloos and other buildings, which were widely used elsewhere. They were not needed at this plant, however, due to the wide spacing between buildings and lines (APC 1944:39).

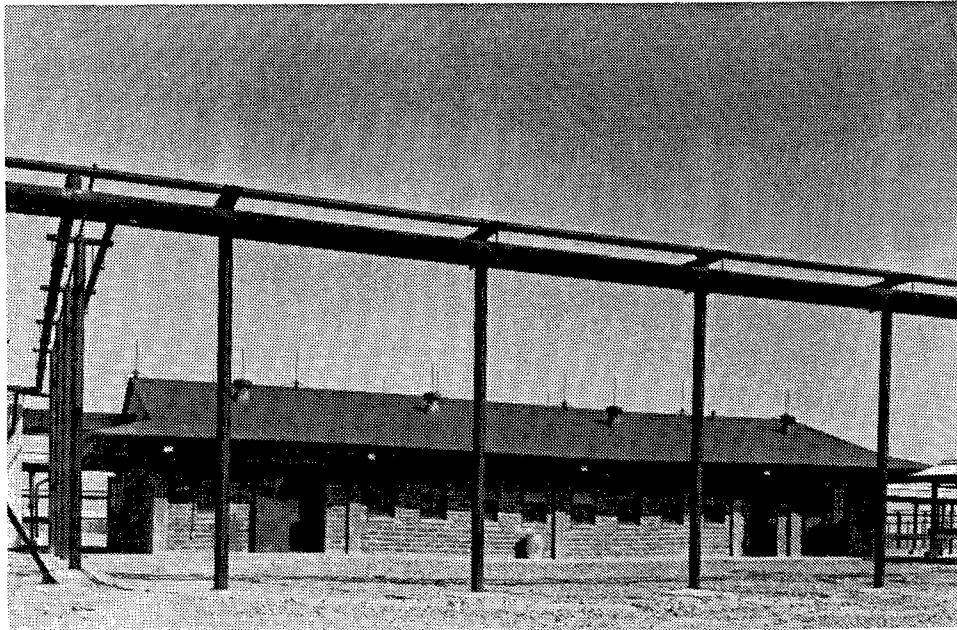


Plate 16. Ca. 1942 photograph of M22-Booster Detonator Assembling Building D-16, Detonator Line, Fuze and Booster Area, completed March 4, 1942. The plate shows the above ground steam lines (U.S. Government n.d.).



Plate 17. Hunkin-Conkey Construction Company photograph from August 24, 1942, shows the newly completed Ammonium Nitrate line (now called Line 12) at the Ravenna Ordnance Plant. The photograph direction is toward the northwest. Note conservation of trees close to the line, used as a form of protective covering, and above ground steam line (Hunkin-Conkey Construction Company n.d.).

During the design process, perhaps the most difficult and time-consuming factor was the coordination of reviews and changes by the various participants to the over 12,500 drawings that were ultimately prepared by the architect-engineer (McDowell 1941:89). The many and constant changes in the plans necessitated several versions of each drawing and the addition of innumerable addendums to the over 136 sets of specifications (McDowell 1941:87). The concurrent construction also required the transmittal of not quite completed drawings so that field work could begin. In some cases, construction was started without sub-soil studies or engineering studies (*ROP*, article j).

Main Construction Phase

The Army Corps of Engineers' completion report from 1943 dryly summed up the *ROP*'s construction period:

The actual completion date was July 10, 1942 [although the construction contractor and architect-engineer did not finish their contracts until November 1942]. There were no unusual occurrences other than minor labor disputes. Grading operations and general clean up of the construction area was disrupted at various periods by inclement weather. The construction contractor constructed the job to the best of his ability under the conditions prevailing, such as required speed and enormous volume of labor and materials required. The Architect-Engineer worked in very close cooperation with the contractor and the Office of the Area Engineer (War Department 1943:5).

In reality, the initial construction of the *ROP* represented one of the most significant periods in the plant's history. The plant's original construction schedule was a 10-month period, predicated on the building of approximately 200 buildings (Anonymous 1942:11). Much of the work was performed during a very severe winter in northeastern Ohio with land conditions ranging from nearly bottomless swamps to rock outcroppings on the surface. The management of men (over 17,000 at its peak), materials and the subsequent shortages, and equipment spread over thousands of acres under an extremely tight schedule was an accomplishment that today is still highly regarded. Even the addition of several lines and warehouse facilities and a depot did not keep the construction contractors from finishing the greatly expanded project within 18 months of the start of the construction.

A construction contract was awarded to the Hunkin-Conkey Construction Company of Cleveland on the same day as Wilbur Watson and Associates. Similar to the architectural-engineering firm, the construction company had a cost plus fixed fee contract (W 6934 QM-2) with the government (War Department 1944:4). The Hunkin-Conkey Construction Company, self-proclaimed as one of the oldest construction companies in the country at that time, was founded about 1870 (McDowell 1941:21). The Cleveland concern expanded its territory in 1907 to the west coast when it built a concrete plant in Oakland, California, to help rebuild San Francisco after the disastrous 1906 earthquake and fire (McDowell 1941:20). The company built many industrial and engineering structures including docks, mills, blast furnaces, baseball parks for Cleveland and Detroit, and plants for the Goodyear Tire and Rubber Company and the Firestone Tire and Rubber Company in the 1910s (McDowell 1941:20). During World War I, it was responsible for the construction of the Central Army Warehouses in Columbus, Ohio. During the 1920s, the commissions ranged from schools and churches to office buildings and hotels, many in Cleveland, but also in Pennsylvania, North and South Carolina, and New York (McDowell 1941:20). After 1929, heavy construction projects constituted the company's workload, including the Laurel Hill Tunnel on the Pennsylvania Turnpike, the Hayfield Tunnels on the Colorado River Aqueduct in Southern California, and, in partnership with other firms, the Shasta Dam in Northern California and the Whitney Point Dam in New York (McDowell 1941:21). In 1942 the firm built the Cleveland B-29 bomber plant, one of the area's largest war plants, just south of Cleveland in Brook Park (Darbee and Williams 1994:12).

Known as Honkey-Conkey by many of its workers, the company had about one month from the time the contract was signed to the beginning of construction to set up its method of organization for the project (R. Walters, interview 1994). The organizational system was overseen by a General Superintendent, B. J. Bartholomew, a long-term employee of the Hunkin-Conkey company. The organization consisted of traveling superintendents in charge of each major phase, such as excavation, steel, cement, and masonry, with foremen and laborers under them, with group superintendents in charge of each group (or line) of buildings (McDowell 1941:27). A Coordinator was connected by telephone to the offices of the group superintendents, train yards, and the concrete suppliers (McDowell 1941:30). Job meetings were held twice a day at first, and then twice a week between the group superintendents and the main superintendent, supplemented by the weekly Monday morning meetings with representatives from the architectural-engineering firm, Atlas, and the War Department (McDowell 1941:31).

The first ground broken for this immense construction project was for the temporary administration buildings on the west side of the facility on September 25, 1940 (Anonymous, Scrapbook article aa). Although many of the farmers were still in the process of harvesting crops, and holding auctions to sell their personal possessions and farm equipment, this event occurred about a month after the 30-day notice to vacate was issued to property owners. The construction crews managed to work around these activities through October and into November, when an estimated 15 percent of the owners were still on their farms (Anonymous, Scrapbook article q).

The temporary administration buildings in the construction camp included quarters for Hunkin-Conkey, Wilbur Watson and Associates, Atlas, and the War Department, as well as a firehouse, dormitories, and a commissary. The plans for these buildings came from similar designs used in the Shasta Dam construction camp in northern California, a project in which Hunkin-Conkey was a partner. The plans were rushed airmail, and construction company draftsmen adapted them as the excavations began for building foundations. In fact, the buildings were 60 percent complete before the drawings were even printed (McDowell 1941:35).

Construction on the industrial buildings started in late October 1940 (Anonymous, Scrapbook article oo). The initial work began with the railroads, which were the main mode of transport for materials into the different building groups (McDowell 1941:38-39). The group storage buildings and the buildings of Load Line I were the first areas under construction (McDowell 1941:48) (Plate 18).

Subcontractors for the effort were numerous and were usually at work in the plant at the same time. The first subcontractor was the Cuyahoga Asphalt Company, hired to resurface the existing roads that were to be kept for the operations period (McDowell 1941:35). The most prominent was the Cleveland Builders Supply (CBS) Company, which provided concrete tipples, mixer, aggregates, and heating equipment used at the batching plant (McDowell 1941:42). The company's former materials yard near the Classification Yards on the east side of the installation is still called the CBS yard. Over 70 of the major subcontractors were listed in the Hunkin-Conkey construction history, including the more well-known names of Otis Elevator Company, Pittsburgh Plate and Glass, the DeVilbiss Company, Westinghouse Electric and Manufacturing Company, and many additional northeastern Ohio firms providing fences, rubber flooring, electric work, sheet metal, and the monorail system (*Cleveland Plain Dealer [CPD]* 1968; McDowell 1941:90-92). The completion report by the Army Corps of Engineers recorded a total of 181 subcontractors with whom there was "very little difficulty working with them all" (War Department 1944:5).

At the peak of construction in July 1941, 17,000-18,000 people were employed at the plant, which exceeded the number of workers during the operation period by about 2,000 (APC 1943b:26; McDowell 1941:52, 83). Construction workers composed the largest percentage of this figure, and included those who were building the Portage Ordnance Depot at the same time (Plate 19).

The demand for skilled workers was always high, despite the fact that there were as many as 2,000 carpenters, 190 bricklayers and 180 helpers, 254 reinforcing steel workers, 225 structural ironworkers, and



Plate 18. Hunkin-Conkey Construction Company photograph from June 1, 1942, shows the construction of Building 904 in the Ammonium Nitrate Line. The plate illustrates the large number of construction personnel who worked on one building at the same time (Hunkin-Conkey Construction Company n.d.).

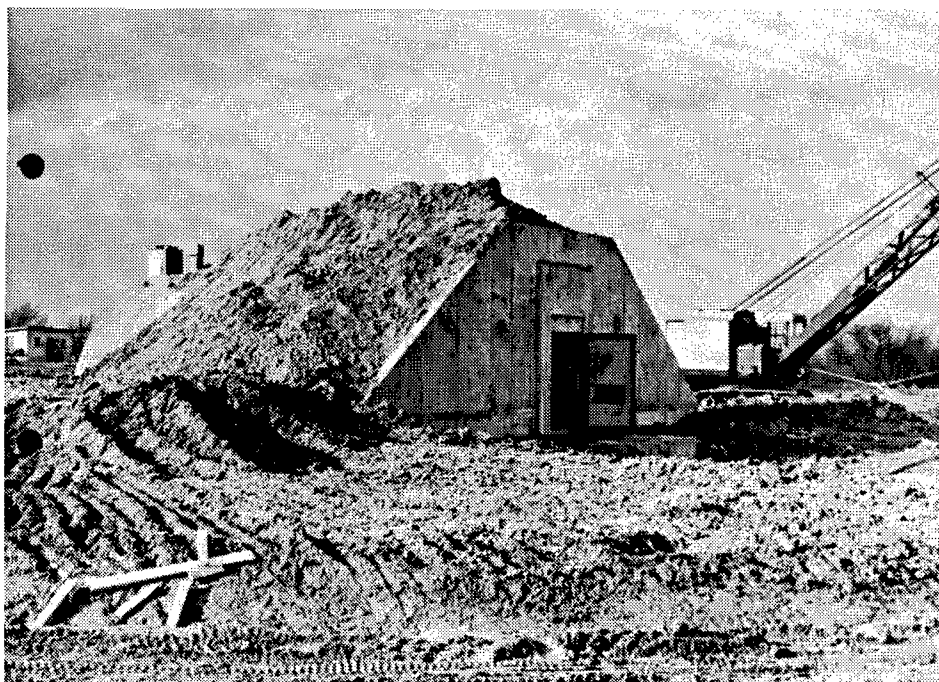


Plate 19. Hunkin-Conkey Construction Company photograph from December 26, 1941, shows the completed superstructure of Igloo WS-3 with topfill partially in place in the Wet Storage Area (Hunkin-Conkey Construction Company n.d.).

800 electricians involved in the effort during the peak of construction (McDowell 1941:43, 44, 125, 128, 132, 140). Laborers, who numbered over 7,503 at the height of construction, constituted the highest percentage of the work force (McDowell 1941:43).

Difficulties During Construction

Weather

Northeastern Ohio has never been known for mild winters, but the winter of 1940-1941 was purported to be one of the worst winters the area had ever experienced. Temperatures went down to 50 degrees below zero, but even more problematical were the freeze-thaw cycles that kept the construction crews scrambling to save concrete floors, newly excavated railroad grades, and equipment that sank into the mud (McDowell 1941:106, 111). Tarps were an essential item during that winter to protect the newly laid concrete floors and the workers themselves; the bricklayers insisted that tarps be laid over the buildings they worked on, gaining them the title, "God's Chosen People" (McDowell 1941:125). Calcium chloride was employed to thaw backfill inside the buildings and under concrete slabs on the sills. It was also used in the mortar as the brick and tile were laid in freezing weather (McDowell 1941:107). The icy roads during that season were particularly dangerous, causing the deaths of, or injuries to, a number of workers.

The spring of 1941 was much more favorable for construction, which by this time included the storage igloos of the Portage Ordnance Depot. The mild dry weather in the spring allowed the Ammonium Nitrate plant to be built on schedule from April to October despite its location in one of the swampiest areas of the plant (McDowell 1941:103). Of course, the severe winter was followed by a broiling summer, but it appears that it did not plague construction efforts as much, except for the crucial set-up time for concrete floors and walls.

Shortages of Materials

A project of this scale and time schedule would have taxed resources in normal times, but the ever-increasing demand for steel, concrete, masonry, and equipment was complicated by the shortages caused by the erection of other such plants in the country and the added demand for materials for the adjacent Portage Ordnance Depot, also under construction by the Hunkin-Conkey Construction Company. A department was established within the company to handle priorities and expedite the procurement and delivery of needed materials (McDowell 1941:85). Field expeditors were hired to go to the sources of supply to speed up deliveries. "Fourteen men do this work, and they cover the entire area from the Mississippi Valley to the Atlantic seaboard, and from Northern Michigan to Alabama" (McDowell 1941:86).

The army was also successful in obtaining needed materials for the plant through "[t]elegraphic and telephonic pressure and personal trips to Washington and plants of manufacturers by the Priorities Officers" (U.S. Government 1942). A higher priority status for the plant regarding materials was finally achieved "after much pressure [was] brought to bear on officials in Washington" (U.S. Government 1942). A blanket A-1-priority rating was finally assigned to the construction of the plant on August 5, 1941 (U.S. Government 1942). Although the company was supplied with a contingent of construction equipment, "*every piece of equipment . . . has been employed constantly since its arrival on the job* [italics in the original]" (McDowell 1941:30).

The installation itself was mined for sandstone and gravel (McDowell 1941:68). Four gravel pits were opened up for needed backfill material for roads and excavated foundations (McDowell 1941:70). Although Atlas deemed the sandstone as "fair quality" and the gravel as "poor," the urgent need for such materials and the handiness of their location could not be overlooked (APC 1943b:275).

The reinforcing steel was supplied by a Cleveland company that fabricated the steel into various shapes and sizes and had to work two shifts to meet the demands of the project. Soon the steel workers had to order 60-foot lengths of steel, since the various sizes could no longer be fabricated in the quantity needed by the supplier, and set up their own cutting and bending yard in the field. Twenty-five buildings in the Fuze and Booster area were constructed in this manner (McDowell 1941:124).

Land Conditions

The Army Corps of Engineers' completion report described the land conditions as ranging from "outcroppings of sandstone at the surface to swampy areas which seem to have no bottom . . . sometimes . . . found adjacent to each other" (War Department 1943:1). These conditions presented the most difficult obstacles to drainage and excavation work during construction. The boggy conditions throughout the plant area complicated the excavation phase in all kinds of weather, but particularly during the rainy season in the fall and winter when the freeze-thaw cycles brought about abrupt sudden changes in the ground conditions (McDowell 1941:68). Both equipment and newly excavated grades were occasionally threatened by these conditions (McDowell 1941:71).

Although surface rock was also a problem, especially in the vicinity of Load Line I, foundation excavations were accomplished through the use of the Atlas company's blasting experts. The clearing of swamps, in which heavy equipment was nearly impossible to use, and the excavation of ditches were also accomplished through blasting (McDowell 1941:67).

Transportation

During the course of the construction phase, changes were forced in the original design plans. The most significant construction changes made to the original plan were the orders to add the detonator, artillery primer, and percussion element lines in January 1941, and the addition or reconstruction of roads. Subsequently, the Load Line IV and 24 inert storage warehouses were added between June and December of 1941, as were the additions to the ammonium nitrate line (APC 1943b:3).

The roads in the area prior to construction were in very poor condition. Therefore, the primary means of transportation within the plant had originally been planned to be by rail. In the early months of the construction phase, though, it became apparent that to facilitate construction either the building of new roads or the near-total reconstruction of existing secondary and tertiary roads within the plant would be necessary to facilitate access to certain utilities and to, in particular, the remodeled farmhouses. It also became evident that additional parking facilities in various areas of the plant would be necessary (APC 1943b:273).

Although many of these farm roads were soon upgraded for their new uses, railroads were chosen as the primary mode of transportation during construction as well as during operations. Lighter-weight narrow gauge rails were installed in the immediate vicinity of some of the building sites near the swampy areas (McDowell 1941:78). Materials were delivered to the different building groups by rail, including the concrete, which was transported to the building sites on a car that mixed the ingredients en route.

Construction Budget

In the first announcement of the Arsenal's proposed purpose to Portage County residents on August 15, 1940, the original cost for building the arsenal was reported to be \$10,000,000. The cost, however, jumped to \$12,000,000 and then to \$18,000,000 in the early months of 1941 (ER 1940a). The original low estimate was predicated on a much smaller scale installation than was finally built. The plan for the original plant was

for approximately 200 buildings, consisting of 137 storage structures, 60 shell loading buildings, and 12 administration and shop buildings (Anonymous, Scrapbook article f). Within months of the start of construction, those numbers and the corresponding costs rose rapidly.

The official summary of costs in the War Department's Industrial Facilities Inventory (War Department 1944:219) reported a grand total of \$61,469,239 expended for the construction of the ROP. This expenditure did not include the depot, however, which was constructed for an additional cost of \$9,252,000 (Anonymous 1943:10). A cost of \$77 million attributed to the ROP, which made it the tenth most expensive GOCO plant in the country, was found only in an article written in 1993 (Murphey 1993:Appendix I:5). It is possible that this last figure includes the fees paid to the construction contractor, the architectural-engineering firm, and Atlas Powder Company for their Title I contract for the design of the plant, but these figures were not located in any sources examined.

A breakdown of the costs indicated that nearly \$5,000,000 was designated for land improvements (about two and one-half times the cost for the land itself, which was \$1,796,000). The machinery, equipment, furniture, and fixtures were just over \$2 million, while the portable tools and automotive equipment totaled nearly \$1.5 million. The buildings were the most expensive item at \$34,367,952; however, with leasehold improvements and service costs the total building expenditure came to \$51,335,803 (War Department 1944:219). The cost for buildings ranged from \$754 for a control house on Booster Line II to \$621,986 for the Boiler House on the Ammonium Nitrate line (War Department 1944:227, 223). The second most expensive building was the Administration Building, which cost \$530,275 (War Department 1944:220).

Completion of the Main Construction Phase

Although only the Receiving and Painting buildings were operational, Load Line I was taken over by the Atlas Powder Company on August 18, 1941, after an inspection by the War Department (APC 1943b:62). Thus, the company's Title I contract, which pertained to the management services for designing the plant, was fulfilled as of this first day of operation on August 18, 1941 (APC 1943b:62). The line as a whole, however, was first put into complete utilization on August 21, 1941 (APC 1943b:310), therefore, accounting for the discrepancy in the dates given in different resources as to the day the first shells were loaded.

Title II of the Atlas contract was not put into effect until March 23, 1942, when the last of the load lines, Booster Line II and Fuze Line II were completed (APC 1943b:63, 258). The other load lines were operational before this date and had already been accepted by the Operating Contractor for maintenance and repair (APC 1943b:257) (Table 7).

Very few problems related to construction were reported in the Atlas histories. Corrosion was experienced in the iron pipes in the Ammonium Nitrate plant which transported the neutral liquor from storage tanks to the evaporating building. Although these were not replaced, the second group of evaporating and crystallizing kettles built in 1942 used steel pipe instead (APC 1943b:17). Corrosion in the lines was also a factor in the water treatment plants, which required additional treating equipment soon after they were put into operation (APC 1943b:36).

Both the architectural/engineering firm and the construction contractor were issued stop orders on October 28, 1942, under which they were to discontinue all work as of the close of business on October 31, 1942. Wilbur Watson and Associates, however, was issued a partial stop order with the final date for work by the architect set for November 21, 1942. The construction contractor was allowed to continue such work as was necessary for the protection of the government property until November 30, 1942 (War Department 1943:4).

Table 7
Dates of Starting Operations and Terminations of Manufacturing Operations by Line
at the Ravenna Ordnance Plant

Line	Starting Date	Termination Date
Load Line I	August 18, 1941	August 15, 1945
Load Line II	November 27, 1941	August 15, 1945
Load Line III	December 10, 1941	December 23, 1943 (June 1945)*
Load Line IV	March 1, 1942 (March 6, 1943)* December 1944* May 1945*	May 1, 1942 January 1945* August 1945*
Ammonium Nitrate Line	November 25, 1941 (converted to Renovation Line on 4/3/44)#	May 31, 1943
Fuze Line I	February 24, 1942	April 1944 (August 1945)*
Fuze Line II	April 17, 1942	April 30, 1943 (re-opened for fuze salvage 10/42, closed 1944)*
Booster Line I	March 17, 1942	May 30, 1943 (February 1945)*
Booster Line II	April 6, 1942	August 1945*
Detonator Line	February 26, 1942	April 30, 1943
Artillery Primer Line	February 25, 1942	August 1945*
Percussion Element Line	September 26, 1942	March 24, 1944

Sources: Voight 1945:268; (*) APC 1945b; (#) APC 1944:IV:1

After November 1942, Atlas Powder Company undertook the numerous additional required construction projects connected with the facility, with the drawings for the projects produced by the Atlas Construction Department. These additional construction projects were undertaken by Atlas as soon as the contracts with the architectural/engineering firm and the construction company were completed and did not reflect omissions or inferior work by the prior firms (APC 1943b:248).

Atlas summarized the necessity for the additional construction projects as follows:

1. changes in the originally specified ammunitions requiring modifications in production facilities;
2. new safety appliances and installations;
3. special machines;
4. additional product control measures;
5. changes in specifications and design by the Ordnance Department;
6. the need for more change houses on the lines due to increased female labor;
7. the need for additional packing and shipping facilities to accommodate greater volumes due to improvements in production; and
8. policy changes and changes in plant requirements (APC 1943b:248-249).

Additional construction projects overseen by Atlas included the construction of a Jumble and Jolt House for detonators as a required product control measure; facilities for pallet loading of bombs with straight TNT due to changes in specifications by the Ordnance Department; two fire houses to supplement the one built in the Administration Area because of changes in plant requirements; and the addition of change houses to accommodate the increased number of women workers on load lines and the Fuze and Booster lines (APC 1943b:249) (Figure 12).

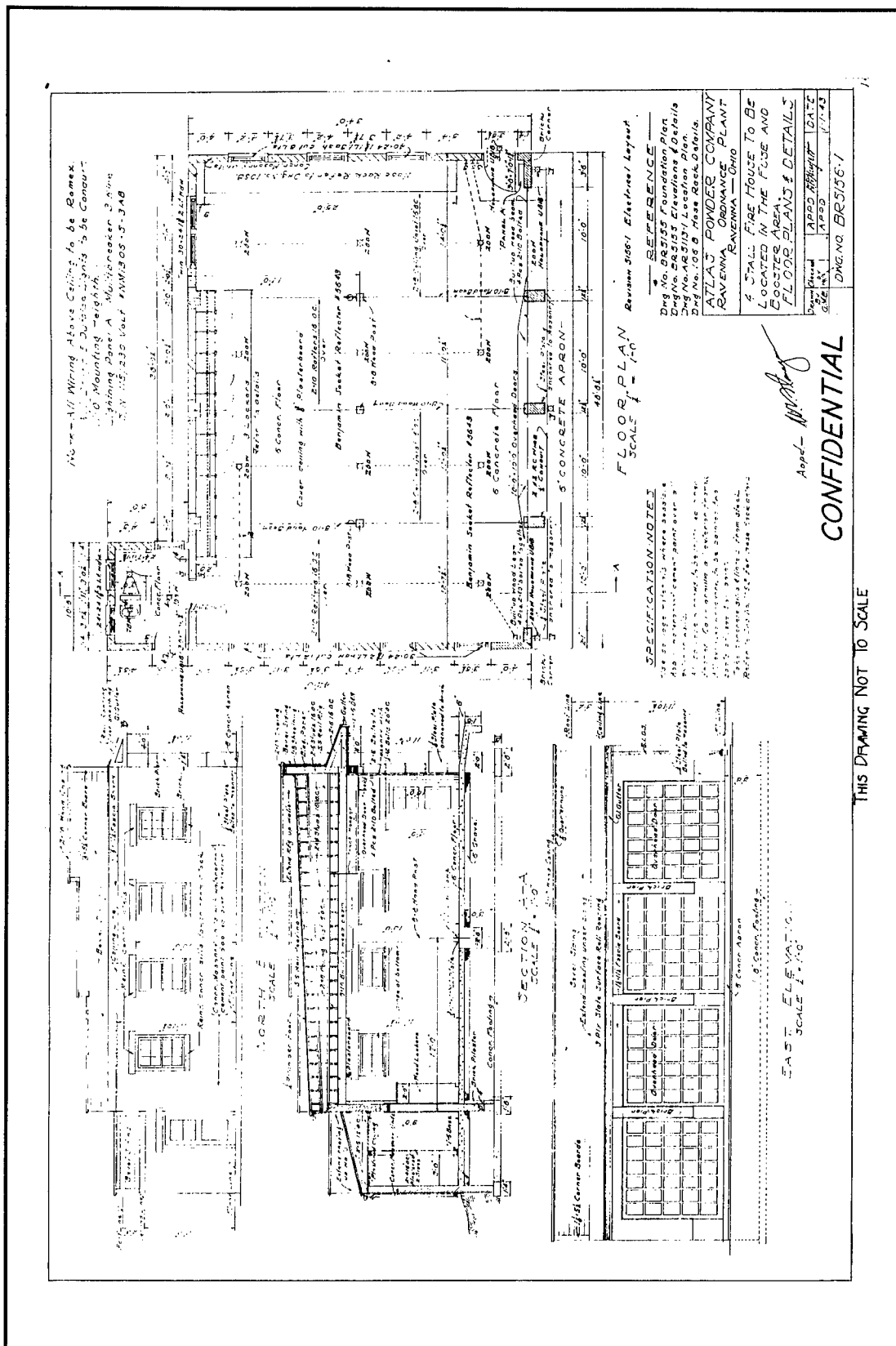


Figure 12. Floor plans and details for 4-stall Fire House to be located in the Fuze and Booster Area, dated 1-1-43, Atlas Powder Company, Ravenna Ordnance Plant, Ravenna, Ohio, Drawing No. BR5156-1.

CONTRACTOR OPERATIONS

On August 18, 1941, Load Line I was officially turned over to the contractor operator. After the first 75-mm complete round was produced and inspected by Ordnance officials, the requirements of the Title I portion of the contract, which consisted of the planning, design, and organization of the plant for operation, was fulfilled (APC 1943b:62). The loading of the first type of ammunition on Line I, a 75-mm complete round with M48 fuze, was begun on August 21, 1941. By the end of 1941, the total number of these shells that had been loaded was 535,342 (APC 1945b).

The remaining lines were turned over to Atlas on March 23, 1942, when the Title II operating contract for those lines was put into effect (APC 1943b:63). Although the date of March 23, 1942, is assigned as the official date for beginning operations, Load Lines I, II, and III were already loading 75-mm, 155-mm, and 8-inch shells as well as the 2,000-pound M-34 demolition bombs by the end of 1941. The ammonium nitrate line was also in production by the end of that year (APC 1945b).

The Atlas Powder Company

The cost plus fixed fee type contract (CPFF) awarded to Atlas Powder Company of Wilmington, Delaware, for the design and management of the ROP was the typical means of contracting during World War II. The CPFF contract consisted of government reimbursement to the operator for all direct costs incurred in running the plant, with a fixed-fee for management added on top. The benefits of the CPFF contract included the incentives it held for private industry to take these contracts in favor of those in the more lucrative private marketplace because of the speed with which these contracts were awarded since there was no competitive bidding, and the flexible pricing due to the lack of information regarding the costs of production. Although widely criticized during World War II, the criticism of the CPFF contract was due in part to its association with the cost-plus contract of World War I, called the cost-plus-a-percentage-of-cost contract, which had been widely abused by contractors.

As the operating contractor for the ROP, the Atlas Powder Company of Wilmington, Delaware, also operated two other GOCO plants during World War II. These were the Weldon Springs Ordnance Works in Missouri, which was a TNT plant, and the Kentucky Ordnance Works in Paducah, Kentucky, which produced TNT and Oleum (Murphey 1993:Appendix I:3, 7). The company was established in late 1912, one of two competitive companies formed by the Du Pont company by court-order as a consequence of its violation of the Sherman Anti-Trust Act (Derdak 1988:343). The two new firms, Atlas Powder Company and Hercules Company, were named after the Du Pont company's two most valuable brands of dynamite, thus giving the new companies proprietary rights to the products (Chandler and Salisbury 1917:293). Both the Atlas and Hercules companies received sufficient production facilities, management, and capital from Du Pont, renamed E. I. du Pont de Nemours & Company, to supply 50 percent of the black powder market and 42 percent of the dynamite market. Du Pont, however, held onto the military smokeless powder capacity, and Atlas never developed a significant smokeless powder capacity (Taylor and Sudnick 1984:33).

Atlas Powder Company, along with Hercules and Du Pont, was active in supplying ammunition to the government in World War I. Atlas also built and operated a nitrate of ammonia plant at Perryville, Indiana, during the war (ROP, article b). The Atlas company diversified after the war into new fields through its concentration on research rather than mergers. The research was devoted to industrial supply rather than retail markets (Taylor and Sudnick 1984:80). By World War II, the company operated several plants, including one at Tamaqua, Pennsylvania, known as the Reynolds Experimental Laboratory. The Reynolds laboratory contained lines for loading bombs, boosters, and primer detonators, and for the production of ammonium nitrate (APC 1943b:344). Supervisors and inspectors for the new operations at Ravenna were trained at this plant, as well as at government arsenals (APC 1943b:344). Other plants operated by Atlas

included the Giant Plant, a powder line, near San Francisco, California, and a plant at White Haven, Pennsylvania, which also had a bomb loading line (APC 1943b:309).

The contracts for the earliest GOCO plants were given to companies with expertise in the explosives and munitions industries. Together, Du Pont, Hercules, and Atlas ran 13 of the 23 GOCO propellant explosive and related chemical works (Kane 1995:26). Unlike many of the later contractors operating LAP facilities, who were chosen for their management expertise, financial soundness, and experience with mass production and storage, the Atlas Powder Company already possessed "technical knowledge and manufacturing experience in the explosives industry" (APC 1943b:54).

That the company was regarded as an expert in the field is shown in its Title I contract with the government to "manage, supervise, direct and control the engineering, design and construction" of the plant (APC 1943b:54). Although the War Department decided to award separate contracts for the tasks of architecture-engineering and construction to other firms, Atlas maintained a dominant role in these areas and was responsible for the design and preparation of drawings for many of the engineering aspects and equipment.

TECHNOLOGY

Briefly, the GOCO ordnance plant system during World War II consisted of 77 plants in 26 of the then 48 states in the nation. Nine basic kinds of facilities were included in the ordnance production program. These facilities consisted of load, assemble and pack (LAP); propellant and explosive works; chemical works; small arms ammunition; case cup; gun tube; magnesium metal powder works; tank plants; and metal components.

The contractors who ran these plants for the government were called either "agent-operators" or Operating Contractors. The first wave of GOCO plants (those built before World War II) was run by companies with experience in manufacturing the desired product. During the second wave of construction, the lack of enough private companies with prior experience in these manufacturing technologies caused the government instead to choose firms based on their financial soundness and their experience with mass production and storage of goods. Many of the later LAP facilities were run by companies such as Procter & Gamble, Sherwin-Williams, and Quaker Oats.

Ravenna Ordnance Plant

The original contract signed on August 26, 1940, between the Ordnance Department and the Atlas Powder Company stipulated that the mission of the ROP was to be "the loading of Fixed Rounds, Shells, Bombs, Boosters, and Fuzes, including manufacture of Amatol and Nitrate of Ammonia from Neutral Nitrate of Ammonia Solution for the foregoing types of ammunition, having an estimated monthly capacity, based on working 500 hours per month [of]:

- 750,000-Fixed Rounds 75 mm H.E., or 3" AA, H.E., or equivalent explosives capacity of other similar types, and
- 175,000-155 mm H.E., or equivalent explosives of other types, and
- 60,000-100 lb. bombs or equivalent explosives capacity of other similar types, and
- 1,000,000-Boosters for the foregoing types of ammunition, and
- 1,000,000-Fuzes for the foregoing types of ammunition

[with all necessary buildings, including] storage buildings adequate for about 30 days supply of incoming materials and about 60 days production of finished work" (APC 1943b:2).

By early 1941, it was evident that the original mission of ROP would have to be modified. Artillery primer, detonator, and percussion element lines were added in February 1941, while a fourth load line was added

in June 1941 (APC 1943b:3). Four more ammonium nitrate evaporating units were added to the contract in March 1942 (APC 1943b:3). The changes in the types of ammunition to be loaded at the plant and the resultant retooling of production equipment on the lines was fairly constant. Table 8 shows the original ammunition scheduled for production and the changes instigated prior to 1943.

The first lines closed down, on April 30, 1943, were the Detonator Line, Load Line IV, and Fuze Line II (APC 1943b:260). The Ammonium Nitrate Line was completely closed down on May 31, 1943, due to a government order to cease loading amatol and to switch to the use of straight TNT (APC 1943b:332). The line was then reconverted to an ammunition renovation line, called Renovation I line, beginning with a trial period of six months that began on April 3, 1944, to "receive, inspect, assort, screen, segregate, load, renovate, recondition, rehabilitate, destroy, store, load on cars, ship or otherwise handle any ammunition (including components and containers) in such quantities as may be directed by the Contracting Officer" (APC 1944:IV:1, VII:40). The Detonator line and Booster Line I were also converted to this effort (APC 1944:VII:40).

Other changes later in the war included the reactivation of Load Line IV in May 1945 for conversion to an "ultra modern shell loading line"; but within a few weeks after the conversion "orders were received from the Ordnance Department to reconvert the line to produce 1,000 bombs of both TNT and Tritonal casts" (APC 1945a:VIII:22). (See Table 7 for the opening and closing dates of each line [Voight 1945:2]).

Atlas's management functions expanded during the course of the war. The most important addition was the War Department's transfer of the management of the ammunition storage facilities to the company in December 1942 (APC 1943b:205). This role included the receiving, warehousing, and shipping of ammunition components and explosives (APC 1943b:205). The Atlas Powder Company took over the management by 1944 of the adjacent Portage Ordnance Depot, which was part of the Field Service Branch of the Ordnance Department (APC 1944:IV:1). This supplement to their contract is first found in the report that covers the period April 1, 1944, to June 30, 1944, and is mentioned as a continuation of these responsibilities "for an additional period of twelve (12) months commencing March 23, 1944" (APC 1944:IV:1). The operation of the depot by Atlas was not mentioned in earlier histories.

The Industrial Manufacturing Processes at Ravenna Ordnance Plant

The Products

The ammunition and component parts loaded at the plant included shells that ranged in size from 75-mm, 155-mm, 8-inch, to 240-mm for howitzers; bombs from 100-pound to 2,000-pound; the assembly of fuzes, boosters, primers, detonators, and percussion elements. An important process at the plant was the graining of ammonium nitrate, used in making amatol for bombs. A press shop produced cups for detonators, primers, discs for detonators and fuzes, anvils for primers, and metal parts for detonators, primers, and relays (APC 1945b).

A shell is a projectile that contains a bursting charge (usually TNT), fuze, and booster. The cartridge case, crimped to the shell in fixed and semi-fixed rounds, contains the propelling charge (smokeless powder) and the artillery primer. A bomb differs from a shell in that, because it is dropped from aircraft, does not need a propelling charge. A bomb consists of a metal casing, with fuze(s), fins to stabilize its flight, and an arming-wire assembly to prevent premature explosion (Olsen 1945:839). The fuze, of which there were many types loaded at ROP, is the mechanism for igniting or detonating the bursting charge of a projectile upon impact or during flight. The detonation is aided by a percussion element and detonator (Hayes 1938:579). The typical fuze has 27 parts, 13 of which are devoted solely to safety (ROP, article d). The

Table 8
Account of Lines and the Ammunition for Which They Were Originally Tooled and Changes
by Spring 1943

Load Line	Ammunition	Changes as of Spring 1943
Load Line I	75 mm complete rounds, both gun and howitzer	Added 4-½" shells
Load Line II	155 mm M-101, 240 mm, 6" MK.2A-1, 8" M-1-3 and M-106 separately loaded shells, and 100 lb. demolition bombs	
Load Line III	100, 500, 1000, and 2000 lb. demolition bombs.	Added 300 lb. armor piercing bombs
Load Line IV	Same as Load Line III, with addition of 4000 and 6000 lb. demolition bomb	
Fuze Line I	M-48 point detonating fuze and M-52 or M-53 fuze for trench mortar bombs	
Fuze Line II	M-48 point detonating fuze, M-51 point detonating fuze, M-103 nose fuze for demolition bomb, M-106 tail fuze for demolition bomb	M-106 fuze discontinued, replaced with M-100 or M-101 bomb tail fuze
Booster Line I	M-20 booster and M-22 booster	All M-22 booster loading facilities transferred to Arkansas Ordnance Plant
Booster Line II	M-20 or M-21 booster, M-102 adapter booster, and M-104 auxiliary booster	M-102 adapter booster kept, but line changed to make M-115 adapter booster
Percussion Element	1 grain percussion element, 30 cal. percussion element	Half the loading equipment changed over to make M-36A1 percussion element and P.E.T.N. drying, screening, and mixing facilities added
Artillery Primer	M22A2, M1B1A1, M-31, and M28A1 primers	
Detonator Line	M-48, M-51, M-52, M-53, M-103 fuze detonator and relay, M-20 and M-22	#253 detonator and booster cap for booster detonator, M-106 fuze detonator and M-26 primer 20 mm fuze added; M-48 and M-51 detonators and relays, and M-20 detonators only items produced from original list; M-22 bomber detonator equipment transferred to Arkansas Ordnance Plant
Metal Parts Shop	All metal parts for above mentioned detonators, relays, primers, and percussion	Line originally tooled for M-48, M-51, M-52, M-53, M-103, M-106 and M-20 detonator metal parts, and metal parts for 1-grain and 30 cal. percussion elements. Some M-48 and M-20 parts made and some 1-grain p.e. parts, but none of the other equipment was used prior to closing the line in spring 1943. Equipment for making M-36A1 p.e. parts added

Source: APC 1943b:51-52

booster is a component part of the shell or bomb that picks up the fuze detonation and transfers it to the bursting charge (TNT) of the shell. The explosive element in the booster is composed of small pellets of tetryl. Artillery primers (fuze primers) were employed to supply the initial impulses in the explosive train for the ignition of bursting charges (Hayes 1938:572).

The explosives used and stored at the plant for loading purposes were TNT, amatol, tetryl, lead azide, and fulminate of mercury. TNT, the abbreviation for trinitrotoluene, was derived from the substance toluene, a coal tar compound, through a comparatively simple process of nitration with nitric acid. TNT was considered the Army's important high explosive because of its great power. The substance's appearance is like harmless powdered brown sugar, which when melted in Dopp kettles for pouring into shells, assumes the consistency of applesauce (Hayes 1938:37-38).

Amatol is a mixture of ammonium nitrate and TNT (50/50 mixture) that was used as a temporary replacement for TNT in bomb and shell loading during a shortage of toluene in the early years of the war. Amatol was used until May 1943, when a straight mixture of TNT was ordered for the loading of shells and bomb (APC 1943b:337). Tetryl was used in small quantities in the booster cups in the form of small pellets. Tetryl is a complex chemical derived from coal tar products. It is in the form of a fine, yellow, crystalline powder. The most powerful of the explosives used in bombs and shells, only a relatively small quantity was used in the booster charge, which was readily exploded by a detonator of the fuze (Hayes 1938:39). Lead azide is a fine, cream-colored compound used as a standard detonator explosive, replacing mercury fulminate because it is less sensitive to shock and more stable. The compound is more readily detonated by flame than shock. The storage requirements for lead azide were either under water or in alcohol (Hayes 1938:40).

Mercury fulminate, the most sensitive explosive at the plant, was used for detonators, fuzes, and primers. The raw materials are metallic mercury, nitric acid, and ethyl alcohol which are mixed in a relatively simple process. Its hazardous nature required the preparation in small lots. Mercury fulminate was always stored or transported under water. It could only be in a dry state during the loading process (Hayes 1938:39).

The Processes

"Ammunition loading is a purely mechanical procedure consisting of a series of mechanical operations many of which are accomplished by means of special tools and single-purpose machines" (APC 1943b:43).

Many different functions were carried on at the plant, which had 12 lines and a machine tool shop. Four lines were for bomb and shell loading, and seven were in the Fuze and Booster area (artillery primer, detonator, percussion element, two booster lines, and two fuze lines), and the twelfth line consisted of an ammonium nitrate processing plant. The machine tool shop provided many of the metal parts used to make the percussion elements, detonators, primers, and relays. Throughout these production and loading procedures, Ordnance Department and Atlas inspectors routinely checked the quality of parts, materials and procedures to ensure the quality and safety of the operations (Plate 20).

The major activity at the plant was bomb and shell loading (Plate 21). On the load lines, brass shells coming from outside the plant were transported from the inert storage warehouses located at the south end of the line. They were first conditioned (rust and corrosion were cleaned from interiors and paint was added to the interiors if they were not able to be sufficiently cleaned) and put on the monorail system to be spray-painted and dried. The shells were then loaded on dollies attached to the monorail system to be taken to the melt load building, where a screening operation was first performed on the crystallized TNT to remove any metal parts. The TNT was then melted and poured in molten form into the shells with rubber buckets (before the use of volumetric pouring machines in 1945). A stirring process to remove air from the TNT was then performed (Figures 13-16) (Plate 22). The booster cavity was drilled into the hardened TNT, and the booster and fuze inserted (some rounds were not loaded with a fuze at the plant). The shell was then crimped to the

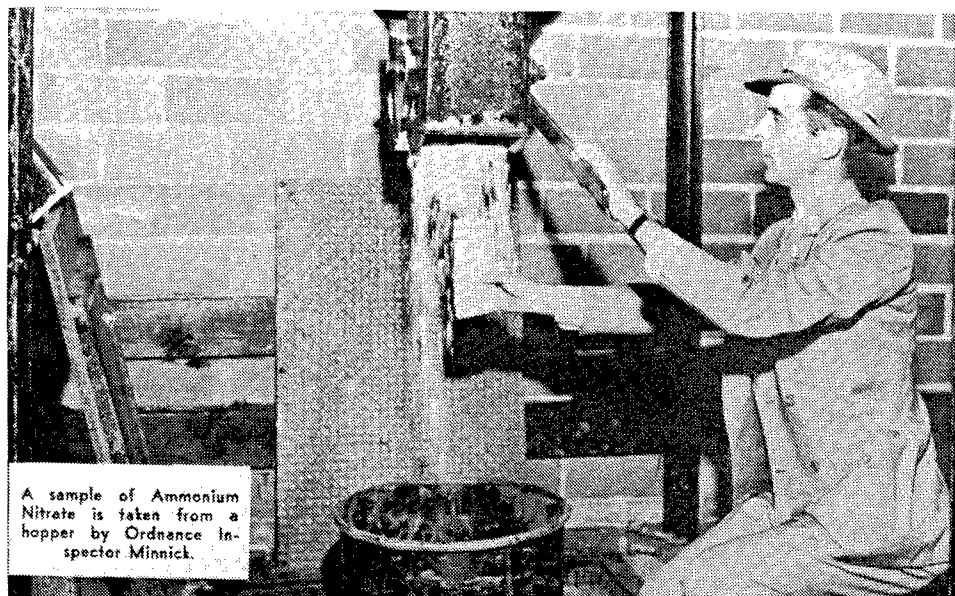


Plate 20. ROP Magazine from June 1942 which shows one of the many daily inspections performed by inspectors. This inspector is taking a sample of ammonium nitrate, used in making amatol (*ROP*, article o, Volume 2, No. 6).



Plate 21. ROP Magazine from September 1941 which depicts the process of shell loading (*ROP*, article h, Volume 1, No. 3).

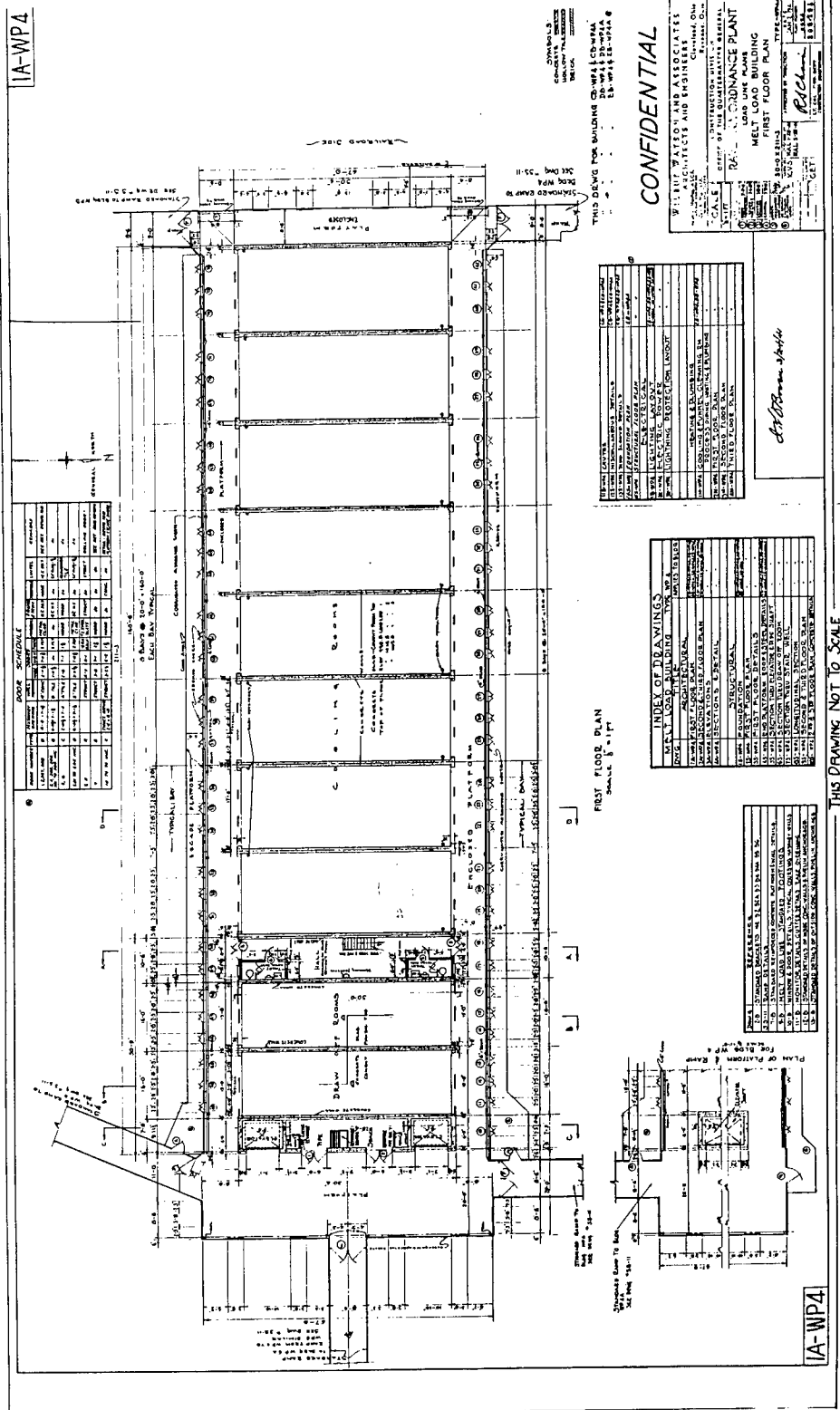


Figure 13. First floor plans for Melt Load Building, Load Line Plans, Type WP4A, dated 1-2-41, Wilbur Watson and Associates, Architects and Engineers, Cleveland, Ohio, Drawing No. 1A-WP4 (308.201).

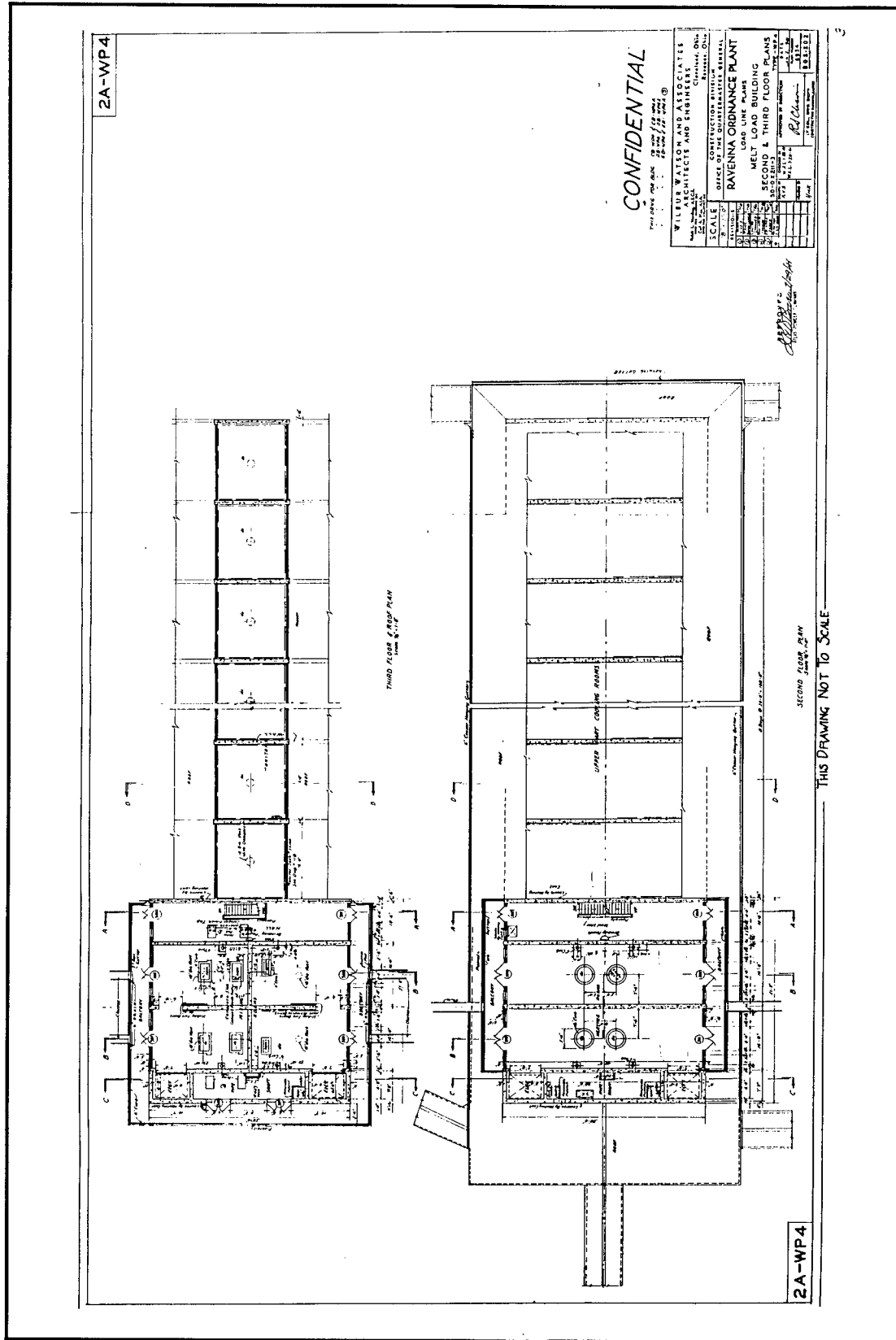


Figure 14. Second and third floor plans for Melt Load Building, Load Line Plans, Type WP4, dated 1-2-41, Wilbur Watson and Associates, Architects and Engineers, Cleveland, Ohio, Drawing No. 2A-WP4 (308.202).

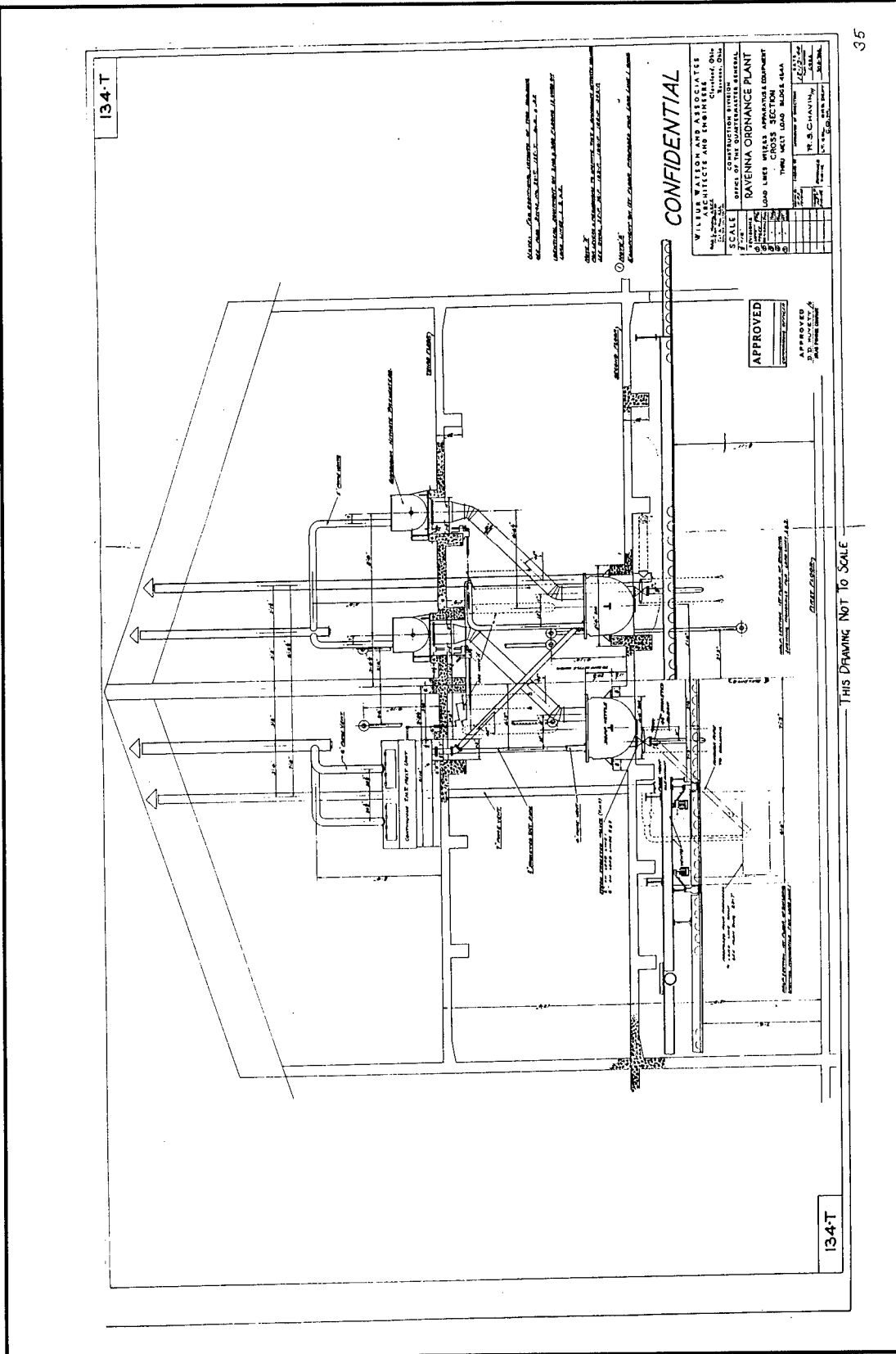


Figure 15. Cross section of apparatus and equipment through Melt Load Buildings 4 and 4A, Load Lines I, II, and III, dated 12-13-40, Wilbur Watson and Associates, Architects and Engineers, Cleveland, Ohio, Drawing No. 134-T (308.704).

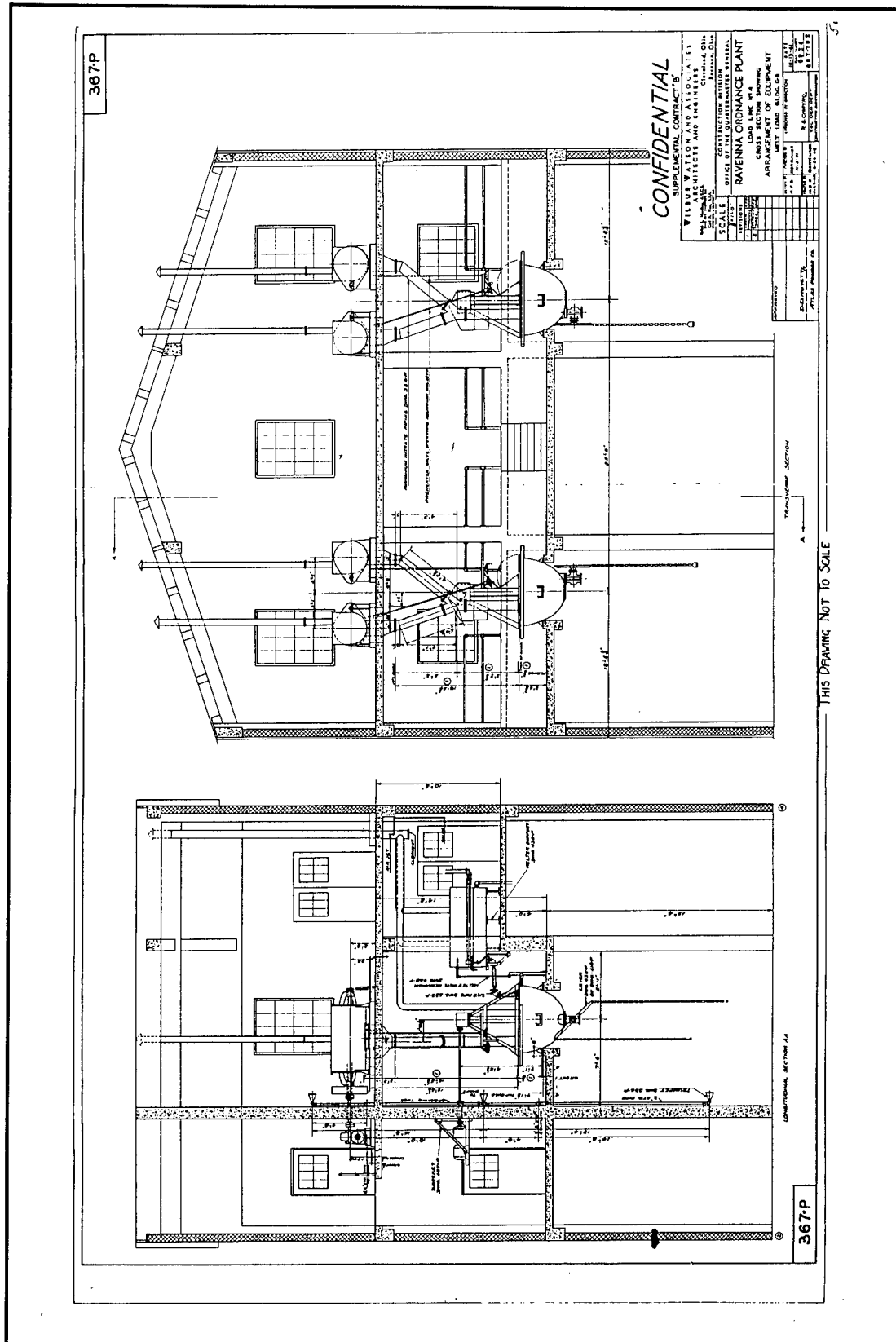


Figure 16. Cross section showing arrangement of equipment, Melt Load Building G-8, Load Line IV, dated 10-15-41, Wilbur Watson and Associates, Architects and Engineers, Cleveland, Ohio, Drawing No. 367-P (407.702).

Below: Helen Hanes, badge 21498, shown stirring melted TNT in a cooling tub, just before it is poured into shells.

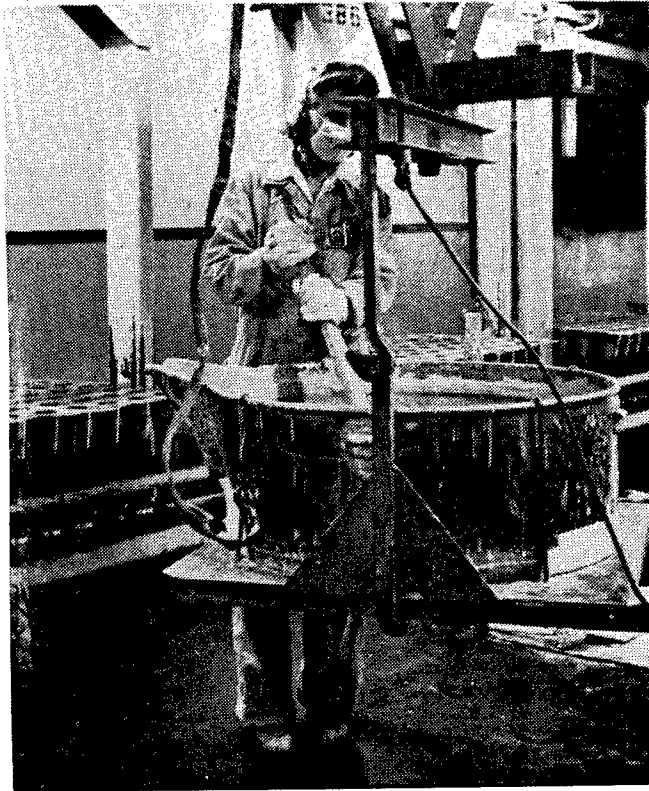


Plate 22. ROP Magazine from February 1943 which shows the puddling process involved in pouring TNT into the shells (*ROP* article 1, Volume 3, No. 2).

cartridge case, which contained the propellant charge and the artillery primer if the ammunition was fixed or semi-fixed (Figure 17). During the packing process the shell was stenciled with an identifiable lot number, packed into a round fiber container, and then into wooden crates for either storage or shipment (Olsen 1945:840).

The Ammonium Nitrate Line, in production from December 1941 until May 1943, produced amatol used for loading bombs and shells in Load Lines II, III and IV. In a specialized plant, the ammonium nitrate was derived through an evaporation and crystallization procedure of neutral liquor in large kettles, which were then transferred to the load line. The explosive was prepared by melting TNT and incorporating it with ammonium nitrate for a length of time sufficient to ensure that each grain of ammonium nitrate was thoroughly coated with TNT (Hayes 1938:38) (Plates 23 and 24).

The loading of the shell's component parts, such as the fuzes, boosters, detonators, and primers, was described in a 1945 article as "largely confined to very simple assembly work" with most of the operations on the primer line mechanized. The loading of detonators, boosters, and fuzes involved bench assembly work; on the booster line "... each minute task is performed at long tables having numerous stations. Although most of the operations are performed by hand, small crimping and staking machines are used at the tables to assemble the various parts" (Olsen 1945:840).

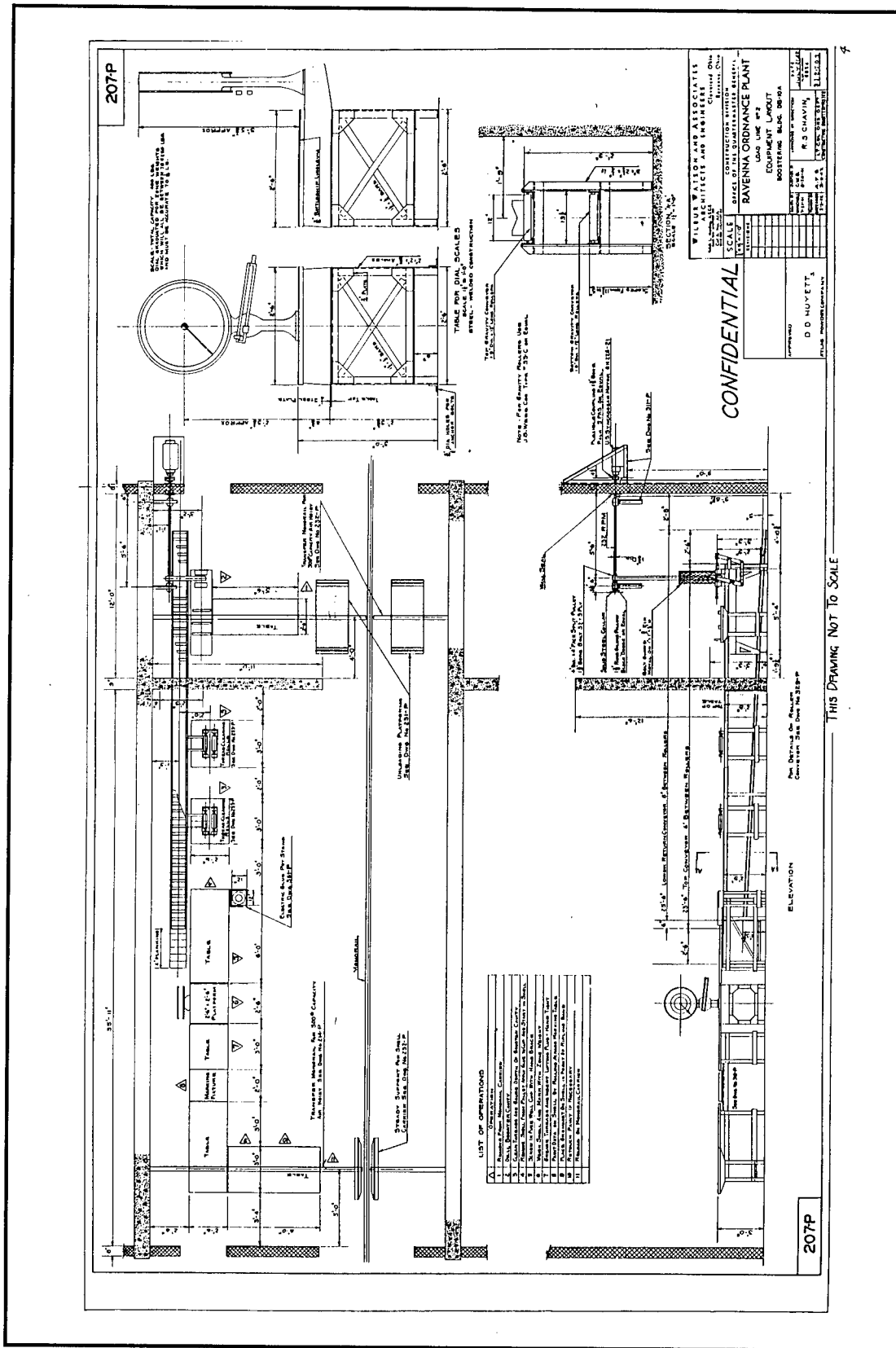


Figure 17. Equipment layout for Boostering Building DB-10A, Load Line II, dated 7-21-42, Wilbur Watson and Associates, Architects and Engineers, Cleveland, Ohio, Drawing No. 207-P (312.703).

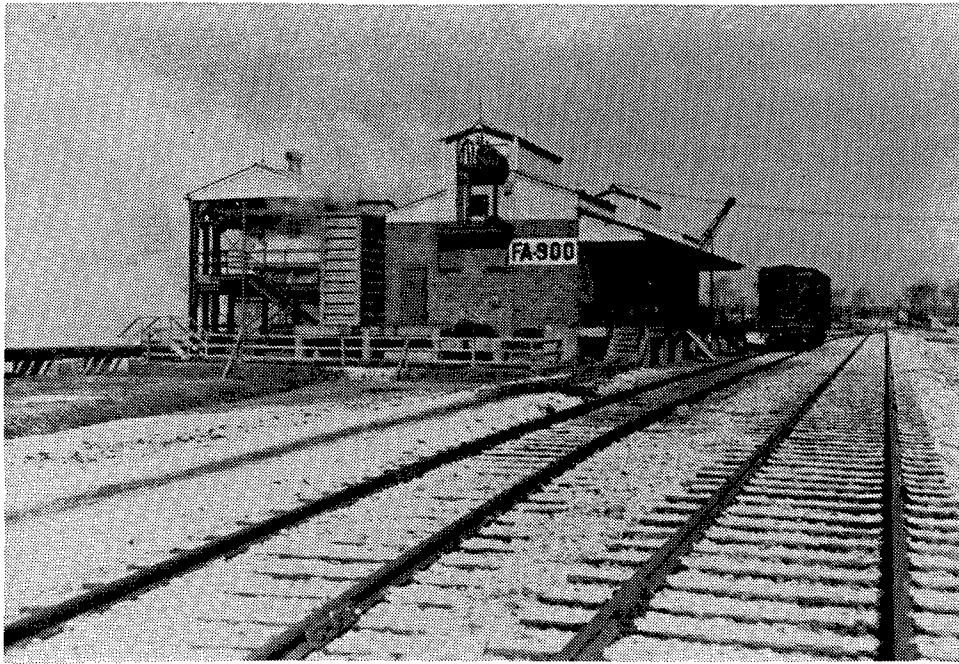


Plate 23. Ca. 1942 photograph of Evaporating and Crystallizing Unit-Kettle House FA-900, Ammonium Nitrate Line, completed November 3, 1941.

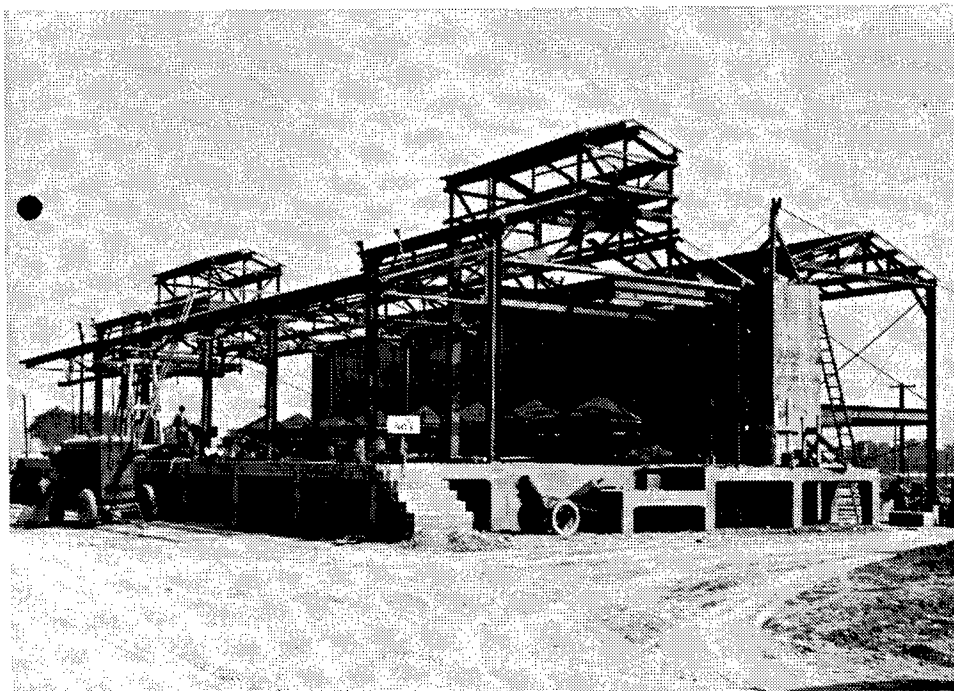


Plate 24. Hunkin-Conkey Construction Company photograph from 1941 which shows in-progress construction of one of the Ammonium Nitrate Line's evaporating and crystallizing buildings. Photograph shows the kettles which were unique to the Ravenna Ordnance Plant (ROP, article 1, Volume 3, No. 2).

The booster line assembly process involved the screening and molding of tetryl into small pellets in a series of steps that were mostly done behind concrete barricades through the use of remote control, due to the highly explosive nature of the tetryl. The pellets were placed in a metal booster cup that was screwed into the booster body. The body contained internal threads that allowed it to be screwed into the fuze and the shell (*The Bombshell*, article c) (Figure 18).

Over the intervening years since the end of World War II, the equipment that produced the ammunition used by U.S. forces has been removed from the facility. Much of it was transferred for use in other more active plants over the past 40 years. Even the two gigantic laundry machines which washed 4,500 uniforms a day were shipped to another plant (Urban, interview 1994). No equipment from the World War II-era plant operation period is left in any of the buildings on the installation (MacDonald and Mack 1984:18; Morgan, interview 1994).

Significant Inventions and Technological Advances that Took Place at the Plant

Numerous inventions and technical advances in equipment, parts, and processes, as reported throughout the Atlas histories, took place at this plant. A few examples of significant inventions and technological advances at the ROP included the Ammonium Nitrate plant operations, which employed improved methods of circulating the neutral liquor into the plant via tank cars, and the changes in the location of the crystallizing kettles which saved on equipment and building materials. The Ordnance Department requested complete plans and specifications of these facilities for use at other plants being erected by the government (APC 1943b:17) (Figure 19). Modifications to the Dopp kettles used to mix the TNT and ammonium nitrate on the load lines constituted another technological advance that was adopted by the Ordnance Department as standard for all its shell loading plants (APC 1943b:13). Another Atlas innovation involved a new design for the method by which shells were painted automatically through the use of a conveyor belt carrying the shells through a spray booth as they moved down the line (APC 1943b:13).

The company's Technical Division was responsible for a number of innovations in equipment in processes including experiments with crating operations, funnels for TNT pouring, and the melt-grids used in the TNT pouring process (APC 1943b:342). The Engineering Department developed an improved automatic self-cleaning drilling machine for 75-mm and 76-mm shell (APC 1944:IV:41-42). The machine drilled at a rate of 18 shells per minute, though it was capable of running faster. Even the press shop came up with a pinch-trim die machine developed for trimming the tops of detonator cups on the eyelet machines (APC 1944:IV:43). Although it was not the first plant to do so, in early 1945 the Ravenna plant installed a volumetric pouring machine for use when loading TNT into 155-mm shells. This device eliminated the hazardous and wasteful method of hand-pouring the molten TNT with rubber buckets into the shell (Quayle 1945:606).

It appears that the Atlas Powder Company employed "state of the art" equipment and processes at the Ravenna plant throughout the war, constantly striving to improve both methods and equipment to further enhance the already-high quality of the products and to save on material and labor costs. The company carried on its research efforts throughout the plant's operation, a process that had started before the war at their extensive research facilities. The Engineering Department, the Technical Division, and even the press shop of the Atlas Powder Company were always actively involved in the improvement of equipment and processes at the ROP, with many suggestions from the employees who worked on the lines implemented through the company's Joint Production Committees. The Ordnance Department's request for plans and specifications regarding buildings and equipment employed in the processing of ammonium nitrate is further proof of the plant's innovative procedures.

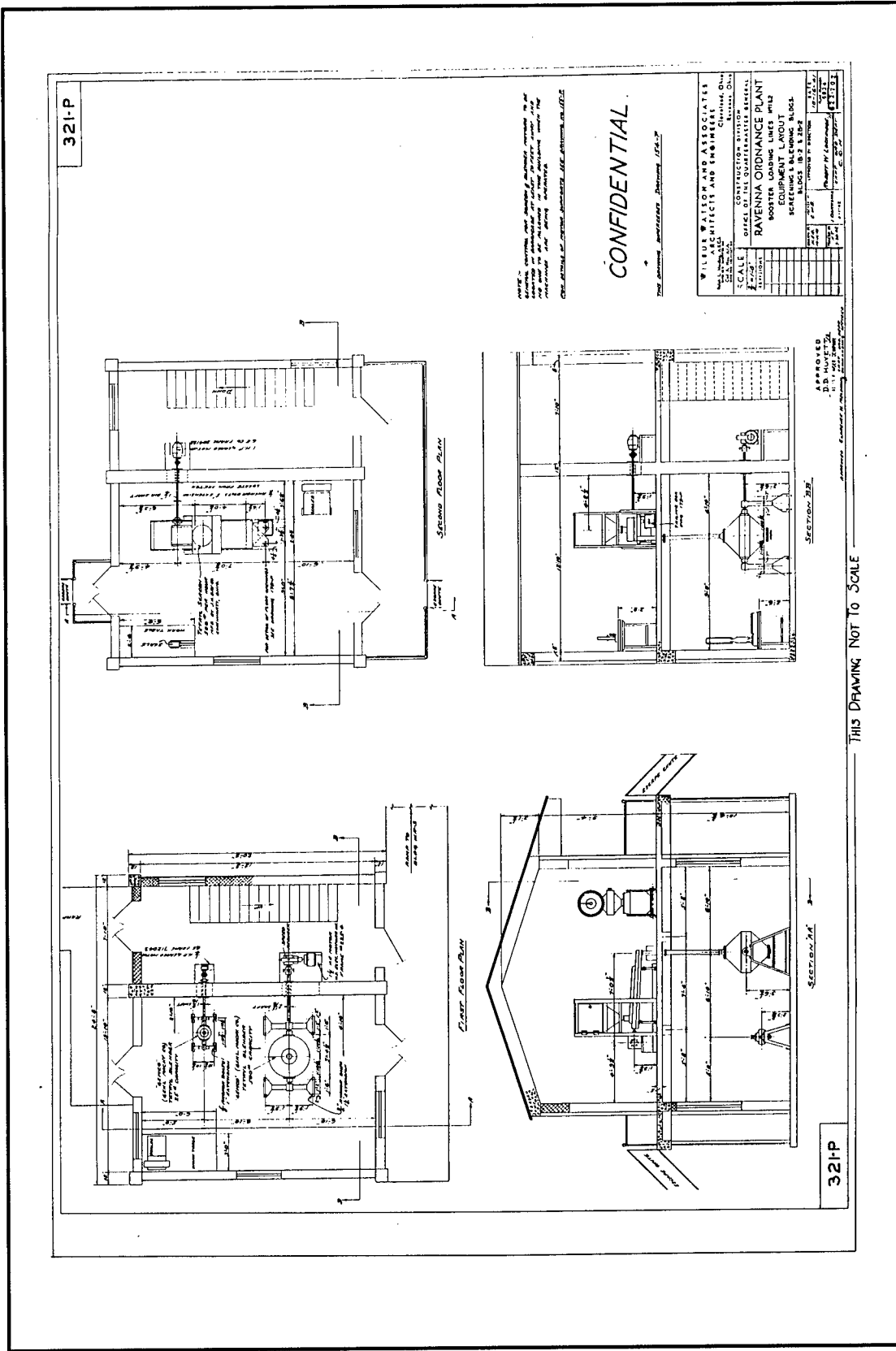


Figure 18. Equipment layout for Screening and Blending Buildings 1B-2 and 2B-2, Booster Loading Lines I and II, dated 10-16-41, Wilbur Watson and Associates, Architects and Engineers, Cleveland, Ohio, Drawing No. 321-P (622.702).

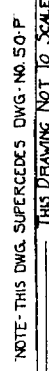


Figure 19. Mechanical equipment cross section through Buildings 900, 901, and 902, Nitrate of Ammonia Plant, dated 6-12-41, Wilbur Watson and Associates, Architects and Engineers, Cleveland, Ohio, Drawing No. 192-P (501.705).

Summary of the Plant's Contributions to the War Effort

The contributions of the ROP to the war effort involved the production of enormous quantities of high-quality ammunition and numerous technical advances that were the result of the Atlas Powder Company's constant improvement of the processes and production of materials throughout the operation of the facility. The ammunition produced at the plant made a significant contribution to the successful campaigns of the U.S. Armed Forces in several European countries, including Italy and France, as well as in North Africa.

SOCIAL HISTORY

Government Land Acquisition and the Local Community

The purchase of approximately 223 tracts of land for the ROP and the forced move of more than 1,300 people comprising 220² families has been called the greatest permanent mass relocation program in Ohio history, that is, until the commencement of the federal Urban Renewal programs in Ohio's major urban areas during the 1960s (Gorisek 1986:15). The acquisition by the government of over 220 parcels of farmland was handled with breathtaking speed in less than two months, an effort which was greatly aided by so little opposition.

The process of optioning the land was accomplished in the first three weeks of August 1940. No one in the community was aware of the project until an article appearing in the *Evening Record/Daily Courier-Tribune* on August 9, 1940, reported that an Akron bank was seeking options for a large-scale project in eastern Portage County. The local reporter had received a call from the County Recorder's office the day before to inform him that 10 agents from the Bankers' Guarantee Title and Trust Company of Akron were optioning land in four townships in eastern Portage County (Troyer 1986). The article speculated that the huge land acquisition was for an airport, although some of the optioned land was quite hilly and it was reported that the railroads were also interested in the acquisition (McDowell 1941:12). Portage County residents learned in less than a week that the options were being taken for a \$10,000,000 bomb and shell loading plant.

By mid-August 1940, 15,000 acres had already been optioned with the expectation that more farmers would give options soon. Some farmers had balked at giving an option until they knew the purpose of the proposed project. All were informed that if the majority of landowners agreed to the sale, then the rest would be forced to sell (ER 1940a).

On August 28, 1940, the same day that Atlas Powder Company was awarded the contract to design and operate the plant, all of the property owners were notified of the government's formal acceptance of their option agreements, which allowed the government to take exclusive possession of the properties. Each landowner was told to "kindly arrange to remove from said property during this thirty (30) day period all crops, livestock and other movable personal property" (McDowell 1941:16). The government did not release payment to the landowners for their property until they had moved from the premises (Paul, interview 1994).

The War Department's Industrial Facilities Inventory from 1944 states that the cost of the land was \$1,796,000. The cost reflected a prorated amount that took into consideration the fact that several tracts of land conveyed by the same owner were within both the ROP and the adjacent Portage Ordnance Depot. The land acquisition turned out to be one of the least expensive items in the final summary of expenses for the plant's erection and equipment (War Department 1944:219).

² A 1941 article states that there were 250 families involved in the relocation (Anonymous, Scrapbook article o).

The options taken for the land in August 1940 had ranged from \$65 to \$100 an acre (*ER* 1940a). According to a map in the Engineering Vault in the former Administration Building at the ROP, the final purchase prices paid per acre varied widely, probably due in part to the assessed value of the parcel and its improvements, and the bargaining skills of the respective landowner. Although the average price per acre was just under \$100, one lot in the town of Windham was sold for six cents an acre, while the high price of \$152 an acre was secured by the Cleveland Trust Company (APC 1943b). Some informants maintained that the government paid far too much for some parcels, ranging as high as five times the market value of the property (McGee, interview 1994). Maurice Paul (interview 1994), whose family owned two farms totaling 337 acres in the northern part of the proposed plant, commented that the price was "beans" compared to today's prices, but he felt that they received a more than fair financial compensation for the properties.

Many of the local landowners who faced eviction were descendants of the original settlers who came to the area in the early nineteenth century, when it was part of the Western Reserve of Connecticut (McDowell 1941:15). Despite this fact, little difficulty was experienced by the agents who approached the farmers about options. F. S. Carpenter, with the Bankers Guaranty and Trust of Akron, the optioning agent, remarked that "the fine spirit with which the majority accepted what may be called the signs of the times was certainly creditable" (McDowell 1941:16). Most optioned their land without even knowing what the proposed plans for their property were (*ER* 1940a).

Estella (Babb) Decker's family was greatly relieved by the government's purchase. Her recently widowed mother was heavily burdened with the management of their 60-acre farm in Charlestown Township. The family had owned the farm for about 20 years when they were approached by the Akron bank agents. The 60-acre farm straddled the Erie Railroad, which was to be the northern boundary of the plant. Because the government only wanted the land between the Erie Railroad and the B & O Railroad, only the 40 acres of the farm that were south of the Erie Railroad were desired by the government. The remaining 20 acres, however, were purchased by the government land agent at the same time and, presumably, later sold to another buyer. Decker's family soon moved to a two-acre farm close to Newton Falls near the plant (Decker, interview 1994).

Later newspaper and magazine accounts of this period, removed by 40 to 50 years, paint a heartrending picture of rich and abundant fields abruptly torn from unwilling landowners by a ruthless government (Gorisek 1986:15). But it seems that while some farms were thriving products of dedicated stewards, other tracts were almost entirely unproductive properties that their owners were happy to sell. The construction crews discovered extensive areas of swamps and near-surface bedrock that certainly were not cultivable by the previous owners. It cannot be denied that the three-week optioning period and subsequent 30-day notice to leave were very disrupting, but most of the concerns were centered on sufficient compensation for the land (R. Walters, interview 1994).

Henry Paul's two farms near Windham were well-improved with four houses, several barns, and a feed and coal business, and were considered to be some of the best property in the area. Although the family was not disheartened by the price they received for their farms, which totaled 337 acres, Henry's son, Maurice Paul, explained that "when you're forced to sell, you don't feel too good about it." Mr. Paul (interview 1994) stated that many of the landowners felt they had no choice in the matter.

About 15 percent of the farmers remained on their land into October and November of 1940 after construction had begun. Although some refused to move at all and others held out for a better price (Anonymous, Scrapbook article q), few went to the length of fighting the government through a lawsuit. Robert Walters (interview 1994) recalls that only one person caused much trouble: the man ran the agents off his land with his shotgun, finally leaving only after the U.S. Marshall was called in to remove him. Estella Decker (interview 1994) remembers only the Strasser family actually taking the government to court; her statement was qualified, however, by the fact that the events on the west side of the area were those with which she was most familiar. Maurice Paul (interview 1994) states as well that there were only a few lawsuits.

The government did not pay the landowners until they had vacated their premises, forcing many to borrow money to undertake the moves (Paul, interview 1994). Undoubtedly most families felt very inconvenienced and were saddened by the forced move. Some were wary about the government dealings in general.

Other people in the county who did not have such emotional and financial issues at stake were very excited by the news. "Restaurant owners, merchants, real estate agencies and businessmen throughout eastern Portage County have visions of a Portage [C]ounty boom"; however, the greatest problem, as foreseen by everyone was the provision of housing for the many employees that would be needed at the plant (ER 1940a). The same newspaper article reported that "[s]everal prominent citizens failed to see any good in the project for the county, since they are inclined to believe that the national defense program on the present scale is one of temporary nature, meaning five or ten years. They question the value of land should the arsenal ever be abandoned" (ER 1940a).

The Fate of Former Landowners and Their Farms

Whatever their feelings about the relocation, the majority of the former landowners carried on with their lives whether they chose to move just a few miles away from their old homes or outside of the county and state entirely. Estella (Babb) Decker's family moved to a two-acre farm that suited them much better near Newton Falls, southwest of the plant. Soon after Estella Decker's graduation from business college in 1942, she heard about positions at the ROP through a government property officer with whom she attended church. She was first employed by the government in the personnel department at the GS-2 level and earned \$1440 a year when she started in October of 1942. Estella Decker worked in the government personnel department at the ROP until her retirement in January 1981, except for the period between 1964 and 1966 when she worked there for the contractor RAI, Inc. Soon after World War II she married Robert Pavlick, whose family's land was also purchased by the government for the bomb and shell loading facility. Like the Decker family, the Pavlick family moved only a short distance away from their old farm near Windham. Robert Pavlick's mother worked in the Fuze and Booster area during World War II. He was in the service during the war but returned to work for the government at the plant in 1946 where he met Estella Babb. He worked at the plant until he was laid off in the late 1950s and went to work at Chrysler (Decker, interview 1994).

After selling their 337-acre farm in Windham, the Henry Paul family moved to Garrettsville, a few miles north of the plant. Henry Paul and his sons started over again with a new feed and coal business in this community. In 1948, after the war, they built a local concrete plant and soon expanded into the building supply business with two lumber yards. Several members of the family are still involved in numerous thriving business enterprises in Garrettsville and Portage County (Paul, interview 1994).

The Hunkin-Conkey Construction Company employed a farm crew during the plant's construction to help grade and plant the tops of the underground storage igloos and to harvest the hay and straw that remained after the fall harvest of 1940 for use in mulching. It is presumed that many of the 56 men who were employed on this farm crew had been previous tenants here (McDowell 1941:129). The first issue of the Atlas Powder Company's ROP monthly company magazine assured its readers that the majority of the farmers whose land had been purchased were given jobs at the plant, which gave them an opportunity to work on their land (ROP, article j).

It appears that many families left the county right away and were never heard of again (R. Walters, interview 1994). After the Farm Security Administration's establishment in late 1940 of a clearinghouse to assist farmers in their resettlement of new farms and to aid with financial difficulties, it was found to be difficult to trace the whereabouts of many families who had been "so widely scattered" (Anonymous, Scrapbook article o).

Other former landowners maintained cherished memories of their old homes and returned to visit on occasion. One family still has annual picnics on the site of their old farm (Urban, interview 1994). Robert Walters recalled a story that one of the relocated farmers rated the apples from his old farm as the very best and that their taste would be instantly recognizable to him. His son tested his father's memory by obtaining some of these apples and presented his father with an apple pie. Upon tasting the pie, his father knew exactly from where the fruit had come (R. Walters, interview 1994).

But not everyone was able to go on with their lives sustained by warm memories or new jobs and homes. Henry Lock, who lives near the plant and worked for Hunkin-Conkey during the construction period and later for the operating contractor after the war, related a possibly apocryphal story about one farmer who was not able to get over the loss of his home. The despondent Mr. Jones returned to his farm shortly after construction started and is said to have hung himself in his old barn. In the early 1950s, Henry Lock and his family moved into one of the old houses within the plant which turned out to be the former residence of Mr. Jones, a fact Mr. Lock tried unsuccessfully to keep from his wife (Lock, interview 1994).

When construction started in September 1940, it is likely that more than 400 houses, barns, privies, and other farm outbuildings dotted the rolling landscape in eastern Portage County. This figure, while not in any way presuming to be an official number, is based on the fact that over 200 families had lived here just prior to their relocation. Throughout the construction period, many of the farmhouses were used as field offices for the many subcontractors who worked on the project. Barns served as warehouse facilities during this period and many of the smaller outbuildings were hooked up to tractors and used to haul tools or as roving temporary shelters for such operations as fingerprinting the construction workers (McDowell 1941:47; Walters, interview 1994) (Plate 25). The Paul family's barn near Smalley and Windham Road was used by the Hunkin-Conkey's cement finishing crews as a precast plant for the manufacture of concrete sills, coping, and water splash blocks (McDowell 1941:136).

Many of the structures were necessarily torn down to make way for the industrial buildings, while others were moved to new locations within the plant to serve as dormitories and residences for construction and Atlas Powder Company workers (Plate 26). The 1943 history by the Atlas Powder Company stated that "50 old houses and barns which were retained for use as employe [*sic*] dwellings and storage" still remained on the plant property (APC 1943b:271). The 1943 Industrial Facilities Inventory noted that "... the majority of structures acquired with the land were demolished during the course of construction. Of those still standing, approximately 58 houses were remodeled for occupancy by employees of the Operating Contractor and Using Agency, some having been moved from their original location. Approximately 22 houses remain standing in original location [*sic*]. Barns and farm buildings remain standing in some cases. None of these buildings acquired with the land are used in the manufacturing process" (War Department 1943:231).

While 15 new single-family houses were built for government personnel, most of the remodeled farmhouses had a much greater density of occupants. The farmhouses were converted into dormitories for single men and women. A newspaper account from February 1941 reported that "three houses on the Paul farm and one on the Johnson place have been converted into men's dormitories. Each house accommodates 18 men but the demand for rooms continues to mount steadily" (Anonymous, Scrapbook article p). The rent for these accommodations was \$3.50 per week. One of the farmhouses served as the home of the nurses who worked in the plant hospital (Anonymous, Scrapbook article p).

Many of the farmhouses retained for workers' housing were lovely but modest frame structures that dated from the nineteenth and early twentieth centuries, as evidenced by photographs included in Historical Record inventories at the ROP. Although a few appeared to date from the 1920s, none of the farmhouses was newly constructed. West of the plant, in what would soon become the Portage Ordnance Depot, the imposing Greek Revival house on the 1300-acre Bolton farm was first used as the home of Colonel R. S. Chavin, the first Commanding Officer of the ROP. The house was converted later in the war as an officers' club (Troyer 1986:n.p.). An enormous frame barn on the same property, reputedly the largest in Ohio, became the



Plate 25. Hunkin-Conkey Construction Company photograph from November 27, 1941, which shows an aerial view looking northwest of the Artillery Primer Line. Note the remaining outlying farms and stands of trees (Hunkin-Conkey Construction Company n.d.).



Plate 26. Ca. 1942 photograph of Windham Road entrance gate and guard house, completed in March 1942. Note Italianate farmhouse, one of over 50 houses retained and remodeled for plant housing, and other farm buildings in the background (U.S. Government n.d.).

administrative center for the Portage Ordnance Depot. The Bolton's stone milk-house was likewise used in the depot administrative area as the telephone building and survived into the 1980s (MacDonald and Mack 1984:58).

A newspaper article stated that in 1949 there were 92 houses on the arsenal property, 75 of which were refurbished farm dwellings that had received little maintenance, a number that is higher than any of the World War II-era reports (*Youngstown Vindicator* 1951). But all the houses used for housing during the war were either demolished or moved off the facility in the 1950s and 1960s (Lock, interview 1994; Paul, interview 1994). The grand Bolton Barn survived into the 1970s. In a 1983 Historic American Building Survey of the plant and depot by MacDonald and Mack Partnership (1984:executive summary), only the Bolton milk barn-cum telephone building and a late nineteenth century stone bridge remained as the survivors of the area's pre-World War II historic agricultural landscape.

During construction, the farm roads and bridges needed for the plant's future operation were rebuilt to withstand the much higher weight requirements of trucks and other construction equipment. Twenty-five bridges were rebuilt during the early months of the construction period (McDowell 1941:35). Only one bridge remains, a late nineteenth century stone arch bridge that is located in the northwestern area of the installation.

The question of the former presence of schools and cemeteries and their subsequent disposition has proved elusive to this date. Some believe that there were no cemeteries, "or maybe only little ones" in the acreage purchased for the plant (McGee, interview 1994; Morgan, interview 1994; Paul, interview 1994). Others maintain that there were four churches in the area that had adjacent cemeteries, which were all exhumed during construction. Maurice Paul, who lived near Windham, states that he was very familiar with the whole area and that there were no cemeteries at all and no churches. An examination of the 1909 U.S. Geological Survey (USGS) topographic map of this area showed two churches south of Windham, but it is not known if they were still in existence in 1940. A third church was located in the Portage Ordnance Depot area (USGS 1909). Common knowledge of rural settlement patterns and the evidence from the 1909 map suggest that there were indeed cemeteries within such an extensive acreage, but they were probably small family plots rather than large burying grounds. Several cemeteries do lie nearby in Newton Falls, just outside the plant; the Charlestown cemetery was narrowly excluded in a later round of property optioning (Anonymous, Scrapbook article f). No school houses were located within the installation's borders; however, a schoolhouse in Windham just north of the plant was the first office for the surveying crew from the Wilbur Watson and Associates firm (McDowell 1941:6).

The requirement for maintaining safety distances between the structures and the plant borders and the individual load lines and storage buildings resulted in the preservation of thousands of acres of heavily wooded lands. The specific directive from the War Department and Atlas Powder Company dictated that trees be retained to provide as much natural cover of the area as possible. In 1943, the Army Corps of Engineers reported that of the more than 21,000 acres within the plant, 5,000 acres were woods and brush, and 3,000 acres were in meadows, with the balance uncultivated (War Department 1943:2). During the latter years of the war, however, the agricultural bounty of the area did not go to waste. Through the use of permits made available to all employees in July 1944, plant employees were allowed to fish in the ponds and gather the ripe fruit from the orchards (*Bombshell*, article a).

Boomtown Phenomenon

On the national level, the boomtown phenomenon that affected all of the communities in close proximity to the immense GOCO plants brought welcome economic stimulation as a result of new jobs. The employment boom occurred initially during the construction period and was followed by seemingly unlimited opportunities for all who wanted to work at the plant. Jobs that had been so scarce during the previous decade of the Depression were now plentiful and at wage rates that had never been experienced before.

On the local level, many of the farmers of eastern Portage County regarded the plant as an end to their way of life as they had known it. The businessmen of the county, however, could finally see an end to the dreary years of the Depression. Although most people recognized that housing the many newcomers would be one of the most serious problems, no one could foresee in August 1940 the magnitude of the problems that would be generated by the influx of new people to the area (*ER* 1940b).

The plants needed more workers than the surrounding rural communities could provide. The announcement of the plant's construction spread rapidly to other communities in northeast Ohio and beyond. Newcomers, who were initially transient construction workers, crowded the stores, the banks, the available housing, and the bars of Ravenna and the smaller communities of Newton Falls and Windham, in particular. Concerns about law enforcement, health and other sanitary conditions, and moral issues rose with the growing numbers of new people in the small communities near the plants. Coping with the demands of a population that doubled and then tripled within a few months involved not only an urgent upgrading of the infrastructure but of finding solutions to the social problems caused by the overwhelming numbers of strangers, including African-Americans, arriving in the quiet rural areas.

The Ravenna Ordnance Plant Boomtown

Building "one of the world's largest ammunition loading plants" in rural Portage County affected not only the city of Ravenna but those smaller communities that were located near the plant (*APC* 1943b:43). The population of the surrounding communities soared rapidly, doubling and tripling in size in just a few months. The tiny village of Windham, just north of the plant, grew from 300 people to an estimated 700 by early 1941 (Anonymous, Scrapbook article d). More than 12,000 new residents boosted the 1940 Portage County population of 46,000 throughout the following five years (Dipaolo 1991). Fourteen miles to the west, the community of Warren experienced a rise from 42,413 persons in 1940 to an estimated 50,000 by 1943 (*ROP*, article g).

In the surrounding communities, an early, mixed reaction to the plant's construction included the fears that the project would be fairly short-lived and would create health and social problems that would burden the local agencies (*ER* 1940a). Other residents were concerned that the plant would bring in construction workers who would stay on after the project's completion, which would overtax the already heavy unemployment rolls. This concern stemmed from an earlier, Depression-era experience resulting from a large swamp drainage project in Mantua Township in Portage County (Anonymous, Scrapbook article jj). Estella Decker (interview 1994) echoed the belief that the project would not be of long duration, which increased the difficulty of the newcomer situation in the communities.

In early 1941, prominent members of the county, particularly those from Ravenna, led by Portage County Judge Blake Cook, organized and quickly took the lead in finding solutions to the apparent social problems that included "health, crime, possible prostitution, status of colored workers, recreation, religious, and moral problems and anti-arsenal public opinion" (Anonymous, Scrapbook article r). Known as the Social Federation of Portage County, the group was composed of representatives of many social and law-enforcement agencies who were in unanimous agreement that "a crisis was upon the community and that the price of inaction was chaos" (*APC* 1943b:478). The Federation also included "George W. Thompson, executive secretary of the Association for Colored Community Work [*sic*] in Akron, who stated that the infiltration of Negroes into the community has definitely upset the scheme of life in the district" (Anonymous, Scrapbook article r).

The Federation's general policy was to serve as a network for coordination and assistance. According to the Atlas history, "no attempt was made to organize a representative cure-all for social ills" although the policy was "recognized [in the] state and nationally as an unique and revolutionary form of social engineering" (*APC* 1943b:478).

The purposes of the Social Federation of Portage County were:

1. to promote the welfare of all the people of Portage County, including temporary and permanent employees living within a 15-mile radius of the ROP;
2. to set up divisions of community activities and social groups with experienced leaders;
3. to form any new agencies that may be needed; and
4. to assist such agencies in the solution of problems of the community (APC 1943b:478).

The group had a fair rents committee and a consumer's price committee that investigated complaints of unfair prices (Anonymous, Scrapbook article k). The recreation committee was instrumental in setting up three recreation centers, including the conversion of the Ravenna armory into a center for the construction workers. The committee also requested a doubling of the city's recreation budget from \$750 to \$1500 and floodlights for the Ravenna Athletic Field for night football (Anonymous, Scrapbook article a).

Construction Workers

Among the earliest arrivals in the area were the construction workers and salesmen eager for sales of needed materials for the plant (McDowell 1941:6). Even before construction started, Ravenna's streets were filled with hopeful candidates for construction work who panhandled to tide themselves over (Anonymous, Scrapbook article aa). News of the construction of one of the first GOCO plants spread very quickly, bringing workers whose cars bore license plates from all 48 states (McDowell 1941:39).

The hiring of local people, however, was the priority and the majority of the construction workers were from northeastern Ohio counties. Of the more than 10,000 construction workers who had assembled by March 1941, 10 percent were from Warren in Trumbull County; 28 percent from Akron and 1.2 percent from Cuyahoga Falls in Summit County; 14 percent from Ravenna, 5.3 percent from Kent, 5.3 percent from Garrettsville, and 1.2 percent from Paris in Portage County; 6 percent from Youngstown in Mahoning County; and 14.5 percent from the Cleveland area; the remaining 15 percent hailed from elsewhere (Anonymous, Scrapbook article mm).

Robert Walters, originally from Ravenna, and Henry Lock, from Rootstown in the southern part of the county, were both around 20 years old when construction on the plant began (Lock, interview 1994; R. Walters, interview 1994). Mr. Walters was employed at a local machinist's shop at that time, but quickly got a job at the plant as a guard for the Hunkin-Conkey Construction Company (R. Walters, interview 1994). Henry Lock worked at the Farm Bureau hauling fertilizer and cow feed. He started at the plant as a shovel man digging ditches for the dormitories that were built for construction workers, and then later worked as a carpenter's helper in the Group 5 igloos, and finally as a driver (Lock, interview 1994).

More than 50 percent of the workers at the plant were employed as laborers (McDowell 1941:43). Nonetheless, the growing need for skilled workers caused Hunkin-Conkey to seek men from as far away as Pittsburgh. The Pennsylvania cement finishers were paid at the rates of their hometown unions, which was in excess of the local rate, but it was still hard to fill the demand (McDowell 1941:137).

The construction also brought in a number of African-American laborers. Racially motivated tensions caused at least one unpleasant incident between an African-American man and several white ironworkers that Henry Lock remembers taking place. While Lock was driving the ironworkers from their construction site to the gate, the ironworkers first invited the man into the bus, saving room for him in the back. As he left the bus, however, he was forced to undergo a gauntlet of blows from the ironworkers (Lock, interview 1994). Robert Walters (interview 1994) agreed that the ironworkers were the root of many problems, since they "... flexed their muscles more than anyone else."

An August 1940 newspaper article anticipated that 4,500 construction workers would be employed at the plant which at that time was estimated to cost \$14,000,000 (Anonymous, Scrapbook article nn). The numbers kept growing. "Each day the arsenal builders are adding another 100, 150 or even 200 men to their payroll" was the report of a February 8, 1941, newspaper article (Anonymous, Scrapbook article dd). At the peak of construction in July 1941, over 17,000 people were on the Hunkin-Conkey payroll, the great majority of them employed as construction workers (McDowell 1941:52, 83). A chart prepared by Hunkin-Conkey showed that just under 14,000 field personnel were employed during the week of July 29, 1941 (McDowell 1941:52).

Only limited information was available on the wages paid to the construction workers. Plasterers, steamfitters, bricklayers, plumbers, and ironworkers appear to have been the most highly paid at \$1.50 an hour (Anonymous, Scrapbook article m). Carpenters were paid in the range of \$1.37 per hour by August 1941 (Anonymous, Scrapbook article g). Hod-carriers were paid around \$.85 an hour, while common laborers made 65 cents an hour in February 1941 (Anonymous, Scrapbook article b). As a driver with Hunkin-Conkey, Henry Lock was paid 65 cents an hour (Lock, interview 1994).

The construction workers found housing wherever it was available. Those who lived nearby either drove their cars or shared rides to get to the plant. Some of the young men remained in their parents' homes or, if they were married, lived with their wife's family (Lock, interview 1994; Walters, interview 1994). Approximately 1,000 commuters from Akron and Youngstown and the points in between could take a specially arranged train on the Erie Railroad into the construction site (McDowell 1941:50; Troyer 1986).

Housing for over 2,000 workers was built on the plant during the construction phase (McDowell 1941:55). In early December 1940, the first four dormitories with accommodations for 240 men opened on the plant property. These accommodations were not for laborers, though (APC 1943b:458). Six dormitories with beds for 832 men, two men per room, were erected for the construction workers in the Old Campsite area (APC 1943b:472). Remodeled farmhouses also provided housing; three of the remodeled farmhouses each held 18 men, for which they paid \$3.50 per week (Anonymous, Scrapbook article p). The deluge of workers caused everyone in the nearby towns to open their houses, and even their garages, for boarders (R. Walters, interview 1994). Rents quickly rose for these accommodations, starting at \$5.00 a week, with monthly rents being boosted by as much as \$10.00 per month (Anonymous, Scrapbook articles q, t). The African-American construction workers were forced to set up a shanty town in Paris Township, its conditions, according to the State health director, comparable to those described in John Steinbeck's *The Grapes of Wrath*. Although it was proposed that the workers be moved from the shanty town to plant housing, this does not appear to have happened (Anonymous, Scrapbook article hh).

The construction workers' standards of living appear to have had all the earmarks of typical boomtown conditions. Housing conditions were cramped and expensive for the transient workers, who sometimes had to share a bed in order to get a place to stay (Anonymous, Scrapbook article t). As described above, the African-Americans lived in a squalid shanty town near the plant, which was rumored to have prostitution activity (Lock, interview 1994).

After their long days, the hard-working men crowded into the bars, the most frequented spots in all the surrounding communities near the plant. A popular hangout was the Fourteen Inn, nicknamed Load Line Number 14, at State Route 14 and Route 5 west of the plant (McDowell 1941:122). In the small community of Newton Falls, two side-by-side parlors and a cut-rate food store garnered most of their business from the construction workers (Anonymous, Scrapbook article t). Ravenna's three bars, the Buckeye Tavern, the Brass Rail, and the Royal Castle, not only supplied liquid refreshment, but also cashed the workers' checks on Friday nights since the banks refused to stay open past the normal business hours during the early months of the construction period (Anonymous, Scrapbook article dd).

More constructive pursuits for the workers' free time were gradually instituted. Activities on the plant included a regular athletic program set up by Dr. Wendorf, the plant's physician, a clambake held in a manufacturing building in the Fuze and Booster area, and parades (McDowell 1941:93, 145). The Social Federation arranged for the conversion of the Ravenna Armory into a recreation center for the workers, as well as creating other leisure-time facilities that were made available to the plant employees (Anonymous, Scrapbook article a).

Effects of the Boomtown on the Local Infrastructure

The visible infrastructure changes to the communities surrounding the plant were mainly in the housing developments and the upgrading of roads, but the construction era boom also affected the pace, as well as the face, of the communities. A February 1941 article noticed that "... for five days of the week, Ravenna belongs to the town dwellers--as always--and on Saturday nights farm families crowd the five-and-tens, the movies and the stores--as always. But since the government's new arsenal started springing from the fertile lands of Portage County, Ravenna has been given a new face which it wears every Friday night" (Anonymous, Scrapbook article dd).

Estella Decker remembers that the relations between long-time residents and newcomers were difficult at first. There were so many of the new workers in the area that the problem lay in the uncertainty about what might happen in the near future rather than in competition for jobs (Decker, interview 1994). Disorderly behavior as well as the unaccustomed traffic and crowded conditions appear to have been other major concerns. In referring to the increased arrests for drunkenness and disorderly conduct caused by the "hundreds of itinerants" being drawn into the vicinity, Ravenna's mayor, Seth Sloan, declared, "We're going to need a bigger and better jail" (Anonymous, Scrapbook article q).

Aside from the Social Federation efforts to provide recreation and other amenities for the construction workers, it appears that many residents of the area were reluctant to accept the situation and were preoccupied with speculation about the side-effects of the workers' presence. The community of Newton Falls "bloomed" during the construction period, with two bars catering to the workers, but most feared that the boom would soon dissipate and leave them in the depressed economic state they had been in just before the plant's construction (Anonymous, Scrapbook article t).

In November 1940, private real estate interests were being warned that the federal government would have to step in to build housing because it did not appear that private industry could handle the increased housing needs alone due to anticipated private sector labor shortages and higher material prices, unless "they grabbed it soon" (Anonymous, Scrapbook article ff). The warnings were not heeded, for even in March 1941 the Atlas Powder Company was appealing to developers to build houses for their "permanent" and "supervisory" future employees that would arrive when the plant opened in late summer 1941 (Anonymous, Scrapbook article i). Ironically, the real estate developers were more concerned about the quality of the houses to be built and about the fact that property for federal housing would be removed from the tax rolls (Anonymous, Scrapbook article y). Reluctance also stemmed from the continuing view that the plant would not be a very permanent fixture in the community (Anonymous, Scrapbook article q).

The real estate interests in Portage County finally instigated the construction of 75 new homes in Ravenna in 1941, an increase of more than 100 percent over 1940, which was a big year in itself. Because the communities were focusing most of their efforts on the coming defense workers, most of this construction, however, was expected to house these "permanent" workers as opposed to the "transient" construction workers (Anonymous, Scrapbook article y). Therefore, additional housing was undeniably the most critical need in the community, but it was slow in coming. During the construction period, a March 1941 survey showed the need for more than the 75 homes planned for construction in Ravenna. While this number was

a substantial jump over the past few decades, the survey revealed that 596 rural defense homes were required (Anonymous, Scrapbook articles ii, y).

Not surprisingly, the first defense housing project did not take place in Portage County. The first community to apply for the construction of federal defense housing units was Warren in Trumbull County, which drew "the fire of Ravenna real estate interests" (Anonymous, Scrapbook article bb). Although Warren was removed from many of the boomtown effects of the construction period, the community leaders realized that housing for defense workers was essential (Anonymous, Scrapbook article t). The Warren project, known as Westlawn Homes, opened in August 1941; in the same month 50 trailers (each of which housed four men) were installed inside the plant (Anonymous, Scrapbook article cc) (Plate 27).

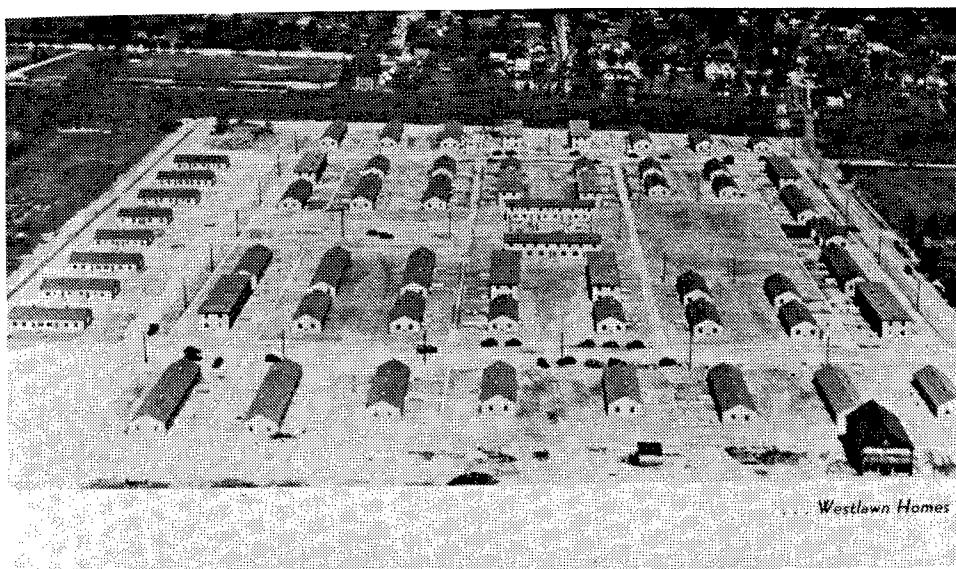


Plate 27. ROP Magazine from October 1941 which shows an aerial photograph of Westlawn Homes in the community of Warren in Trumbull County, the first of nine housing projects built by the federal government for arsenal workers in the vicinity of the Ravenna Ordnance Plant (ROP, article f, Volume I, No. 4).

More defense housing projects continued to be established after the plant began operations; however, the majority of these temporary units were in the Trumbull County community of Newton Falls.

Although no specific information was found regarding the sanitary systems in the nearby communities during the construction period, the necessity for extended systems was under "serious study" in Ravenna in January 1941. However, the final disposition of the types of projects was not found (Anonymous, Scrapbook article y). The ROP was completely self-sufficient in these arrangements as two sewage treatment plants were built within the facility.

Although many of the farm roads within the facility were kept in use, they were closed to public traffic for obvious reasons. The most pressing project was the upgrading of the proposed militarized Route 5, the southern border of the plant, which was at first only scheduled to be built from Warren on the east to the B & O Railroad bridge near one of the plant's western entrances. The Portage County Board of Commissioners and the chambers of commerce of Kent, Ravenna, and Akron sought the extension of this route to the west to connect with Route 14. This extension would then join the plant, via Route 14, to Route 18 which was a direct link between Cleveland and Pittsburgh, two cities considered to be the most probable sources for the

steel needed in construction. The road improvements were also sought because of the increased number of accidents on the narrow, unimproved road (Anonymous, Scrapbook article ee).

Other road projects included upgrading of Route 176, the Charlestown Road. The road was widened from 16 to 22 feet, with a bituminous top on it between Newton Falls and the Portage County line. The same road was improved within Portage County to the arsenal. Both projects had been ordered by the federal government, which bore the entire cost of the improvements (Anonymous, Scrapbook article u).

Information on vehicular parking appears to be limited, for only two articles regarding parking were found in the scrapbook newspaper articles. Although the communities of Kent and Tallmadge were both initially concerned about the takeover of their parking facilities near the train depot by construction workers who commuted to the plant by train, the problem of parking appears to have been only minimal (Anonymous, Scrapbook article n). Nearer the plant, Route 627 was a regular place for construction workers to park, a practice soon outlawed by the Portage County sheriff's officers. The parked cars narrowed the heavily traveled road to a single lane (Anonymous, Scrapbook article kk). Within the facility itself, the plant's self-sufficient infrastructure extended to its parking areas; after operations began, however, many more areas were added.

Although the mayor of Ravenna prophesied that a new and bigger jail would be required to contend with the disorderly events which occurred soon after construction started, only one other report of crime was found in the information about the construction period. In January 1941, three African-Americans from Akron were held in the Portage County jail on suspicion of beating a plant guard. The case was referred to federal authorities (Anonymous, Scrapbook article e). A February 1941 newspaper article reported that there was "surprisingly little drunkenness and Ravenna's six policemen--which include the chief--seem able to handle the situation although the chief has asked for an extra man" (Anonymous, Scrapbook article dd).

During the construction period, the Hunkin-Conkey Construction Company had a large guard force that checked all persons entering the plant. Most of the men in this force were hired by Atlas after operations began on August 18, 1941, with Load Line I starting production. Shortly after, "[i]n order to strengthen the power of the guard force in the performance of its duties, the entire body, in the first week of September, was sworn as Special Deputy Sheriffs of Portage County, Ohio. Some 299 officers and men took the oath administered by Sheriff Fitzgerald, in impressive ceremonies at the Court House at Ravenna, and were addressed by Judge Blake C. Cook" (APC 1943b:393-394).

The area hospitals were tested when a train wreck occurred on March 17, 1941. An Erie commuter train carrying construction workers collided with a freight train just outside the arsenal. Over 300 injured men were cared for at the plant hospital and at facilities in Warren, Ravenna, Youngstown, and Akron (Anonymous, Scrapbook article z; McDowell 1941:58). After the plant was put into operation, the 26-bed hospital on the arsenal provided a larger proportion of medical and surgical treatment for non-job-related illnesses and injuries than in most munitions plants because of the lack of hospitals in nearby communities and the larger number of workers at the plant (APC 1943b:443; U.S. Government 1942).

Effects of Construction-Era Boom on the Local Economy

The construction-era boom helped lift the communities of Portage County and western Trumbull County out of the lingering effects of the Depression through the employment of a large base of local workers for construction, the push for the accompanying new infrastructure projects, and the increase in business for local establishments. The Works Progress Administration (WPA) rolls were rapidly cut by the demand for workers. In the fall of 1940, the Portage County WPA roll was cut down to 600 persons, the lowest figure in the county's relief history (Anonymous, Scrapbook article q). From the start of construction in September

until late November, 150 workers on the rolls found private employment, a season in which the rolls usually grew larger (Anonymous, Scrapbook article w).

The arsenal construction, however, produced no boom in farming. The agricultural interests were negatively affected by the boom because the project removed thousands of acres from production and left few workers for farm labor. Farmers were concerned about a coming shortage of labor for spring farm work in 1941, for they knew they would be unable to match the wages paid to the construction workers. Other farmers were turning away from their former occupations to work on the arsenal, turning their farm management over to renters and share farmers (Anonymous, Scrapbook article l). The construction project also took an estimated 8,219 acres out of crop production and thousands of additional acres out of pasturage, calculated at a loss of a quarter of a million dollars a year (Anonymous, Scrapbook article c).

Concerns about the removal of so many acres of taxable land from the county tax rolls, particularly with regard to the repayment of school bonds in the vicinity of the plant, also clouded the benefits of this project to the community. In February 1941, Congressman Dow Harter of Akron introduced a bill in the House of Representatives that proposed that the federal government reimburse Portage County for lost taxes due to the federal acquisition of the land, as had been done with the Tennessee Valley Authority project. The purpose of the bill was to help the local school districts with the payment of school bonds. The land acquisition removed \$600,000 from the county tax duplicate (or tax roll) and \$9,000 in taxes which would have a serious effect on the local schools and the retirement of their school bonds. Although no follow up articles were found on the outcome of this bill, it was obviously successful in some form because the federal government is still responsible for the Windham School District (Anonymous, Scrapbook article h).

A slight increase in business was reported by the merchants of Newton Falls, but the fact that it was concentrated in the beer parlors made "old timers fear this can not last long." This community had suffered greatly during the Depression due to the closing of the Republic steel mill in the 1920s and feared the return of that recent past (Anonymous, Scrapbook article t).

The construction company's payroll was drawn on the Second National Bank in Ravenna, which along with the First National Bank, jointly announced in early February 1941 that business hours would not be extended to cash payroll checks despite protests from many Ravenna merchants (Anonymous, Scrapbook article x). Since bars were the most notable recipients of the construction workers' cash, three of the Ravenna saloons and the Newton Falls bars offered check-cashing services to the workers. This practice was instituted as a convenience as well as an incentive to the workers, because the banks at first refused to extend their banking hours on Friday nights. In Ravenna, the Buckeye Tavern did not charge for the service, but the Royal Castle rounded the check total down to the nearest dollar and kept the pennies, and the Brass Rail charged a ten-cent service fee (Anonymous, Scrapbook article dd). Within two weeks of this announcement, both banks established Friday night and Saturday hours. The Second National Bank cashed 8,600 checks totaling \$3,000,000 on their first Friday night (Anonymous, Scrapbook article s).

Organized Labor and Labor Relations

The labor unions of the American Federation of Labor (AFL) profited from the construction work because the Hunkin-Conkey Construction Company had a closed-shop agreement with them. Most of the workers at the plant were required to obtain AFL membership before they were hired for work (Lock, interview 1994). Membership in all of the representative unions increased, but the greatest gain was for the Common Laborers and Hod Carriers' Union. Membership in that union grew from around 700 when the ordnance plant was started to approximately 3,300 in the early months of 1941 (Anonymous, Scrapbook article b).

An early battle was waged between the AFL and the Committee for Industrial Organizations (CIO) for the construction work at the ROP. Because the AFL had a closed-shop agreement with the Hunkin-Conkey

Construction Company, they maintained it would keep the CIO out of the project entirely. Albert Dalton, the business representative of the Cleveland AFL Building Trades Council declared that "the Ravenna project is one job on which the C.I.O *[sic]* won't work a man. They can organize all they want to, but this job will be 100 per cent A.F.L." The CIO railed against the Federation's "entrenched position on government sponsored projects," but they were not successful in gaining any of the construction jobs at the plant (Anonymous, Scrapbook article j).

With the increased pace of construction, three-shift days as well as Saturday, Sunday, and holiday hours were instituted with double-time payment for the weekend and holiday work. In July 1941, however, an agreement was made between the AFL and the government Office of Production Management to change the double-time to time-and-a-half pay. The agreement also stated that "... there shall be no stoppage of work on account of jurisdictional disputes for any other cause" (Anonymous, Scrapbook article m).

These clauses came into effect on August 1, 1941. In protest over the cut in overtime pay and in defiance of the national agreement, 2,000 skilled workers at the ROP did not show up for work on that first Saturday of the month, which idled an additional 1,000 workers. An estimated 12,000 AFL workers struck at five GOCO plants that day, among which were the Plumbrook plant in Sandusky, Ohio; the Weldon Springs plant in St. Louis; and others near Kansas City, Missouri (Anonymous, Scrapbook articles ll, gg). After a week of negative press, the bricklayers, ironworkers, cement finishers, and other craftsmen were back on the job--at time-and-a-half overtime pay (Anonymous, Scrapbook article gg). This walk-out was the most serious event in labor relations at the plant. The only other serious strike took place in early December 1941 after operations had begun and involved workers on Load Line I.

Beginning in September 1941, four unions attempted unionization of the plant as they claimed the majority of the workers there. These unions were the National Arsenal Workers of America, Brotherhood of Locomotive Firemen and Enginemen, Switchmen's Union of Northern America, and International Association of Machinists (APC 1943b:118). The matter was not resolved until a strike occurred on Load Line I on December 3, 1941. On that day, 43 workers were absent, while 297 did not report to work the following day. The company responded by placing other laborers on the line "to take up this manpower." Following the attack on Pearl Harbor, however, all operators returned the morning of December 8 (APC 1943b:315). Although Atlas deemed the strike "ineffectual," another history of the plant said that it "seriously hampered production" (APC 1943b:120; Voight 1945:4). Five days after the workers returned to work, an agreement was entered into with the four unions on December 13, 1941, and rate increases were granted to the workers in these unions (APC 1943b:120).

Immediately after Pearl Harbor, the leaders of organized labor, practically without exception, pledged that there would be no strikes in wartime. The National War Labor Board was established to authoritatively settle all labor disputes not settled through collective bargaining and mediation (Polenberg 1968:23). Agreements and collective bargaining arrangements were continually negotiated from throughout the years of World War II production until the end of operations at the plant (APC 1945a:IX:13).

Although the unions were primarily AFL, a small number of CIO unions represented workers at the plant (APC 1944:VI:4). These unions included the United Gas, Coke and Chemical Workers of America (CIO) and (AFL), International Union of Operating Engineers (AFL), United Association of Plumbers and Steamfitters (AFL), International Association of Machinists (AFL), International Brotherhood of Electrical Workers (AFL), and United Brotherhood of Carpenters and Joiners of America (AFL).

Minor work stoppages over the replacement of white workers with African-Americans and disputes over regulation clothing appear to have been the only serious incidents of labor difficulties (APC 1943b:270, 315).

War-Time Operation of the Ravenna Ordnance Plant

Number of People Employed Throughout the War Era

Early estimates for the number of workers that would be needed to operate the Ravenna plant totaled about 6,000 people. Although half of this work force was anticipated to be women, the early estimates at first proposed that no married women be hired (Anonymous, Scrapbook article v). A survey in March 1941 revealed that 2,247 county residents were interested in employment at Atlas; of that number 1,578 were men and 669 were women (Anonymous, Scrapbook article ii).

When operations started in August 1941, many of the Hunkin-Conkey construction workers accounted for the 524 employees on the Atlas payroll at that time. The number grew to a total of 13,472 employees by July 1942, the highest recorded employment number in the Atlas histories (APC 1943b:80).

The number of people hired between August 1941 and July 1, 1943, showed a steady rise from late 1941 to a high of 3,331 hires in March 1942. The numbers of new hires in each month after March 1942, however, steadily declined and dropped to a low of only 44 new employees in May 1943 (APC 1943b:90). This decline in the numbers of new hires is also reflected in the number of employees in the plant at that time. The number of people working at the plant dropped in the spring of 1943 from 10,300 on April 1, 1943 to 7,732 on June 1, 1943 (APC 1943b:110).

Because of labor shortages and the increased demand in production after D-Day, heavy recruitment in 1944 and 1945 was initiated by Atlas. Although the total number of employees is not reported in the histories from this period, it is assumed that the numbers were down from 1943 because of the expanding military enlistment and the probable streamlining of plant operations. The number of employees who were still at the plant when production stopped in August 1945 is not known.

Continuing Boomtown Effects of the Ravenna Ordnance Plant on the Area

Defense Workers Housing Projects

The two housing construction projects for defense workers that finally came on line in August 1941 were the first of nine federal housing projects to be built in the surrounding communities (Table 9). These federal projects were meant to provide temporary housing for workers until private sector interests could meet the demand. By 1943, developers were building more permanent housing under programs established by the Federal Housing Authority for sale or rent to war production workers (APC 1943b:479).

In March 1942, the third federally sponsored project was the Cotton Corners Dormitories for women located just east of Ravenna. Built by the Farm Security Administration, the project consisted of eight one-story buildings with 457 beds. In Trumbull County, three trailer camps and a demountable homes project were built in Newton Falls between November 1941 and February 1943. Demountable houses were a form of prefabrication that employed a system of panels which were easily disassembled and were used throughout World War II for residential, commercial, and industrial purposes. The number of units in these projects totaled 1,200. Because so much of this new housing for defense workers was located in the small Newton Falls community, the federal government authorized the Hunkin-Conkey Construction Company to build a new community center there. Nineteen dormitories added at the plant in 1942, mainly for single men and women, were built by the Federal Public Housing Authority. Although the Atlas history states that the total capacity of these buildings was 1140 persons (APC 1943b:472), the housing survey conducted by their

Table 9
Federal Housing Projects in the Vicinity of the Ravenna Ordnance Plant

Name and Type of Project	Location	Number of Units	Date of Completion
Westlawn Homes	Warren, Trumbull County	200 houses (150 added 1942)	August 1941
ROP Campsite Trailers	Ravenna Ordnance Plant, Portage County	147 beds (50 trailers)	August 1941
Trailer Camp No.1	Center St., Newton Falls, Trumbull County	237 trailers	November 30, 1941
Cotton Corners Dormitories for women	1 mile east of Ravenna, Portage County	457 beds (8 buildings)	March 1, 1942
East River Gardens	Newton Falls, Trumbull County	350 houses	April 1942
Trailer Camp No. 2	Klingeman Rd., Newton Falls, Trumbull County	113 trailers	May 1, 1942
ROP Dormitories*	Ravenna Ordnance Plant Portage County	474 beds (8 buildings) 621 beds (11 buildings)	December 20, 1942 December 20, 1942
Trailer Camp No. 3	Ridge Rd., Newton Falls, Trumbull County	500 trailers	February 8, 1943
Maple Grove Park Houses	Windham, Portage County	2,000 houses	July 1943

* number of beds differ according to source.

Sources: APC 1942:18; APC 1943b:472; ROP, article a

Industrial Relations Department in 1942 recorded that the available beds only numbered 1095 (APC 1942:18). The largest project, Maple Grove Park, was completed in late 1943 in Windham just north of the plant. The 2,000 unit project, also built by Hunkin-Conkey, was "designed to provide a self-sustaining, model community. It will take care of all of the housing needs of Ravenna Ordnance Center employees" (APC 1943b:475). The community had a retail center, a school, 24-hour day care facilities, fire and police, a library, and a community center (War Department 1944:209).

Despite the demand for housing, many of these facilities were not filled to capacity during the war. Complaints of substandard construction, dangerous intersections near the project, and the lack of recreational or retail amenities were common, according to a survey in late 1942 by the Division of Housing in Atlas' Industrial Relations Department (APC 1942:n.p.). Many units in these projects had been reserved for defense workers at the ROP, but due to the low vacancy rates, other workers in the area were allowed to move in (APC 1943b:472).

Newcomers continued to migrate into the area, although they sometimes found it difficult to become acquainted with the long-time residents. Peggy Williams came to work at the plant in 1942 from Tamaqua, Pennsylvania, close to Atlas' Reynold Experimental Plant. Her neighbors who worked at that plant told her about the opportunities in Ravenna. She remembered that people were not very friendly at first, which caused her to pack her clothes "so many times." But she remained, found that people became friendlier, and met her future husband in the shell drilling area on one of the load lines (Williams, interview 1994).

Labor Shortage

The demand for labor was seldom in abeyance. At first the demand exceeded supply because the surrounding community could not provide enough workers. After the war started, inductions were a major source of turnover at the plant. The company made "concerted efforts" to obtain occupational deferment for those already on the Atlas payroll (APC 1943b:258). Between August 1941 and July 1943, however, the plant lost more than 3,000 people to the Armed Forces (APC 1943b:108). The number of terminations from August 18, 1941, to June 30, 1943, totaled 16,114 (APC 1943b:109). The Engineering Department's constant need for skilled workmen, which were in short supply because of the competition of other war-related industries in Northeastern Ohio, caused them to set up an apprentice system in the machine shop in 1942. Labor shortages in 1943 had caused Atlas to begin using more women in different operations on the load lines, a move which became extremely successful (APC 1943b:313-314). A shortage of women employees at the plant was the subject of a recruitment and advertising program in the Warren and Youngstown areas. Handbills, posters, newspaper and radio releases, and an essay contest for school children on the subject, "Why Women Should Still be in the War Work" were some of the media efforts used to communicate the urgent need for more defense workers (APC 1945a:VIII:10).

The push for more workers in 1944 included a campaign among the Atlas employees to enlist their friends and relatives to join the work force at the plant (?UNAMEIT?, article c). Atlas received direct access to eight field Employment Services offices as well (APC 1945a:VII:84). Continuing shortages due to the draft and the increased demand for production after D-Day led to recruitment in 1944 of more women and workers from other states, particularly those in the south. These recruitment efforts, called "inter-regional recruitment," took place in states as far away as Arkansas and Florida (APC 1945a:VII:8). Although these recruitments were satisfactory in the numbers of people hired, many times a production schedule change would cause a surplus of workers as soon as additional people were added to the production lines (APC 1945a:VIII:11).

During the 1942 planning for construction of 19 dormitories on the plant, the number to be allocated to women was increased. Atlas had determined that 11 should be for women, and eight for men, a reversal from the original plan because "it could be seen that the future manpower of this plant would be dependent to a great extent on female workers" (U.S. Government 1942:105).

Although the employment of over 3,000 women was anticipated from the start, the original intention was for women to be employed primarily on the Fuze and Booster lines, while the men would be on the load lines (Anonymous, Scrapbook article v; APC 1943b:82). The increased labor shortages due to the draft and higher production schedules caused women to take on work formerly reserved for male labor in many areas of the plant (Plate 28). Female labor on the load lines started in late 1942. Atlas commented that "except for heavy lifting operations the female operators worked out very well. On many skilled jobs, they excelled the male operators" (APC 1943b:322). A patrolwomen platoon started in January 1943 due to the male labor shortage included women who were "of a high type, intelligent and able, and proved instantly successful." Their principal duty was the inspection of credentials, and control of register books (APC 1943b:404). Women inspectors started work on the load lines in mid-1944 (APC 1944:IV:12).



Plate 28. ROP Magazine from February 1943 featuring some of the jobs women took over at the plant due to male labor shortages because of the war (ROP, article 1, Volume 3, No. 2).

The proportion of women employees at explosives plants was found to be in line with the proportional increases in the improvement of safety. At the same time, women who were concerned about working at the plants were assured that "the only industry that is safer to work in than army explosive plants is the women's garment industry" (?Unameit?, article a).

Others had concerns about the femininity of women who worked at the plant, especially those who took over the demanding tasks that had formerly been performed by men. A load line worker at the plant chastised those who felt this way, particularly other women, through the reminder that women "who are privileged to stay at home and listen to your radio, don't be too quick to condemn those women who are spending those same hours working in the factories for they are the ones who are keeping your homes safe for you and yours" (ROP, article m).

Few African-Americans lived in the Ravenna vicinity prior to the plant's construction. Although their numbers grew with the onset of construction, estimates of the African-American population in the area are not known. Many commuted from the larger industrial communities of Akron and Youngstown. African-Americans composed most of the employees in the plant's laundry, where "[f]rom the beginning it was the policy of the company to use colored employees at the laundry, starting with white supervision, but endeavoring to employ workers who could later be promoted to supervisory positions should vacancies occur.

This plan has worked out very well" (APC 1943b:430). When African-Americans were later employed on the load lines, early walk-outs by the whites occurred, however, when African-American workers replaced white workers in some of the areas (APC 1943b:322). The first African-American female workers came to Load Line III on in December 23, 1942. These "three colored female service workers, who were transferred from another department . . . were used to replace the male operators in cleaning operations, so that the male operators could be placed back on production operations" (APC 1943b:322). The positions filled by other African-Americans at the plant is not presently known; however, it is likely that they were employed as laborers and in the maintenance department.

Segregated housing was standard in the plant dormitories; the projects or neighborhoods outside of the plant where African-Americans resided is not known. The lack of dormitory space for African-American women in 1945 temporarily halted efforts to recruit women from Youngstown (APC 1944:VI:16). Recreation activities were also segregated; African-Americans had their own club, known as the Lion's Club, which met at the plant's recreation center (APC 1943b:480). It appears that African-American workers were also segregated on the load lines early in the production period. By early 1944, in effort to integrate African-Americans, one of the duties of Atlas' Personnel Section was ". . . to assist supervision in the integration of employees on the Load Lines, particularly Negro employees" (APC 1944:III:54).

During the labor shortages in 1944, a limited number of people who had been injured on the job at the plant were employed in other areas of the facility. After D-Day and the resulting sharp climb in the production schedule, "[i]ncreasing use was made of negro women, also students and teachers on vacation, handicapped persons and minors." Atlas commented, though, that "for handicapped persons, job opportunities were extremely limited." A large number of boys were hired to work in unrestricted areas, where legally permissible, while a few girls worked in the Commissary and on certain clerical positions (APC 1944:IV:6).

Others in the work force employed at the plant included older women, numbering about 90 employees at the facility. Atlas proudly stated that 66 of the 90 had children in the armed forces. These women were employed in all lines of work at the plant (APC 1945a:VII:46). Although the use of retired men and prisoners of war at the plant was not mentioned in the Atlas histories, the employment of foreign workers was considered in 1945. Atlas went so far as to check on the availability of housing for them at the Maple Grove Park housing project in Windham. No later mention was made in the Atlas histories as to whether or not this plan was carried out (APC 1945a:VIII:10).

Everyday Life in the Plant

Safety

The issues that governed almost every aspect of the plant were the safety measures and practices at the facility (Plate 29). In addition to the safety measures implemented for the buildings, which included the spacing between them, explosion-proof fixtures, rubber floors, safety chutes, and suction vacuum cleaners to pick up TNT crumbs, employees were often reminded that personal carefulness was just as important, if not more so, than the physical measures. Employees on the load lines were checked especially for matches and wore "powder shoes," non-sparking rubber-soled shoes.

The safety and health of the employees were watched over by the hospital staff, who administered 100 mg of Vitamin C and checked the blood pressure of those in toxic exposures (APC 1943b:446-447). Exposure to TNT caused rashes and other skin conditions, particularly when the weather was warm, and seemed most to affect the women (APC 1943b:331-332). Therefore, workers were tested for their sensitivity to TNT prior to placement on the load lines. People found to be allergic to the substance were transferred to other lines (APC 1944:VI:15).



Plate 29. ROP Magazine from November 1941 which shows some of the safety measures instigated throughout the Ravenna Ordnance Plant (ROP, article k, Volume I, No. 5).

An igloo explosion on March 24, 1943, at the Portage Ordnance Depot was the most serious incident during the war years. Although the cause of the explosion is not definitely known, the event seems to have taken place while cluster bombs were being loaded into the igloo. Eleven people and the igloo instantly vaporized (CPD 1968). Many of the informants interviewed during the current research phase remembered a loud explosion which could only be heard east of the depot. Everyone was sure it was one of the load line buildings (which are on the extreme east side of the plant) because of where they heard the sound (Decker, interview 1994; Lock, interview 1994; G. Walters, interview 1994). The incident is not mentioned in the Atlas histories, nor were there any reports of any other explosions.

Industrial accidents were the most common safety issue at the plant. Although Ravenna's record was relatively admirable throughout the war, the number of employee injuries, particularly those to fingers and eyes, were cause for concern to the company (ROP, article t). The concern was with both employee welfare and the resulting lost time in production. During the war years, the plant had two no-lost-time-accident months (APC 1945a:IX:21).

Training, Education, and Absenteeism

Because the shell loading industry was new to the state and to private industry, Atlas formed several training programs for their employees. A Job Instructor's Training Course was mandatory for all supervisors,

foremen, and trainers who taught others how to do a job. Foremen and "foreladies" on the Fuze and Booster lines were sent to Picatinny Arsenal for training (APC 1943b:348).

The women who worked on the Fuze and Booster lines underwent a training session which included an induction talk, a motion picture which showed the process of assembling the components, instruction on names of parts and functions, and practice sessions under simulated working conditions. So that production would not be hampered by absences, the women were trained on every subassembly so that they could fill in anywhere on the line (*ROP*, article c).

Absenteeism was a major problem at the plant, particularly in the latter years of the war. In a 1944 survey of shell and bomb loading plants, absenteeism at the ROP averaged 9.9 percent and was as high as 14 percent in some departments, when compared to the industry average of 6.9 percent (*?UNAMEIT?*, article b). The small percentage of employees who were responsible for these high figures were mainly hourly workers on the load lines. During January 1945 severe winter weather caused many of the workers to be absent. Despite the weather, however, many did get to work. One load line worker walked seven miles and another rode five buses to reach the plant in the blizzard which marooned many people (APC 1945a:VII:47).

A three-step program was developed in 1945 that helped reduce absenteeism. The program encompassed efforts to improve the accuracy of the absentee reports through establishing a procedure for the proper use of a leave of absence, conducting personnel investigations into the reasons for absenteeism, and instigating a policy of termination for chronic absentees. The program "had a wholesome effect on border-line cases" (APC 1945a:VII:10-12).

Efficiency and Patriotism

The ROP's production slogan "We Fight When We Produce," was chosen in September 1942 to stress the importance of "Production Soldiers in the World Conflict" (*ROP*, article e). Production was kept at a high level through the use of three-shift days, the suggestion campaigns for safety and efficiency improvements, and the practice of training workers for various positions, producing flexible workers able to fulfill many different jobs as needed. Shortages of components, defective materials received at the plant, labor shortages, or the transfer of workers to other lines to meet more urgent production schedules were some of the reasons for unmet schedules.

Atlas formed Joint Production Committees in cooperation with the War Production Board in September 1942, composed of five groups which reached into all departments. The committee members were elected by the employees and included "men and women, white and colored" (APC 1943b:489). Suggestions were accepted and reviewed by the committee and the Engineering Department tested the safety (the most common) and production suggestions submitted by employees, many of whom made important contributions to a safer and more efficient environment (APC 1943b:492). Awards for accepted ideas were in the form of war savings bonds and stamps (APC 1943b:491).

The War Department informed the ROP that it had been selected to receive the Navy "E" Award on April 17, 1943 (*ROP*, article p). Actually called the Army-Navy Production Award, it recognized the efforts of those working in production plants for the war effort. The award came to the plant because of the "cooperation among all workers and management, and among all organizations which have had to do with the construction and operation of the Ravenna Ordnance Plant" (*ROP*, article q). A special ceremony was held in front of the Administration Building on May 9, 1943.

The encouragement of patriotism and morale was clearly a part of the workers' daily lives at the plant. Numerous articles in the Atlas Powder Company magazine, which was called *ROP* (for Ravenna Ordnance Plant), provided reminders about how important the workers were to the efforts against Hitler and the

Japanese. Other articles compared people who did not change their tires regularly or who were absent from work to those who sided with Hitler (*ROP*, articles u, v).

Workers' morale was helped through many articles in the newsletters that carried personal information about births, weddings, engagements, and achievements in the various departments. The newsletters also reported the activities of the sports teams and the patriotic efforts, such as the Red Cross sewing circles. Tips on conservation of food, tires, and other materials in short supply also aided workers struggling through the mandated rationing periods.

A payroll plan for the purchase of War Bonds was started in April 1942. In July, the plant received the "Minuteman" flag after 15 of the 25 departments registered a 100-percent participation total in the program (*ROP*, article s). By December 1942, 90.4 percent of all employees were participating in the plan (U.S. Government 1942:98).

Other morale- and patriotism-building programs included the "Keep 'Em Shooting Program" in 1942. The program was tested at seven plants (one of which was Ravenna) and publicized the fact that it took 18 people behind the lines to supply one soldier at the front. The effort was supported by rallies, newspaper articles, car stickers, and buttons (APC 1943b:495).

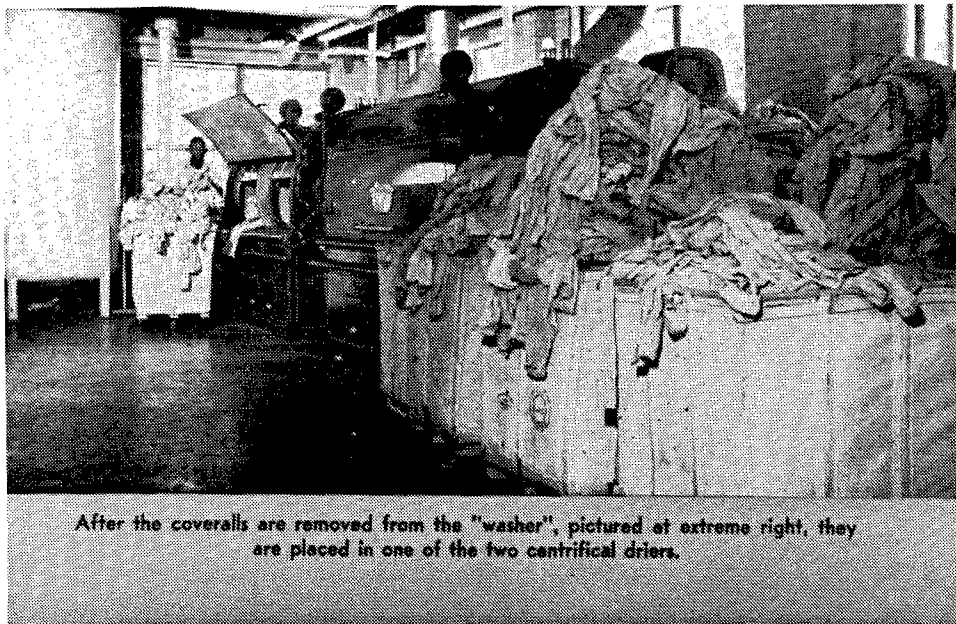
Uniforms/Laundry

All load line workers were required to wear special uniforms on the load lines. The two-piece pale brown uniforms, trimmed in dark brown, did not have pockets or had mesh pockets so that nothing could be brought into the plant that was not visible. Load line workers were required to have a clean uniform every day, which they would don in the change houses associated with their load line. The laundry operation at the plant was responsible for cleaning 4,500 to 5,000 uniforms every day (Plate 30). Load line workers and those who were on the Artillery Primer Line had their uniforms washed after every shift (*ROP*, article i). The removal of TNT was the most problematical; the use of alkali alone caused the cloth to be dyed a blood red. The solution was to melt the TNT off the uniforms first (APC 1943b:436). Rags and gloves from the Artillery Primer line were so flammable that they were brought in cans of water to the laundry to prevent spontaneous combustion (APC 1943b:437).

Employee Services Offered at the Plant

A tremendous variety of services was offered at the plant to help employees cope with various wartime situations resulting from the hardships due to rationing of gas, food, and other materials, as well as the limited housing facilities. Other services were offered that helped provide a semblance of community life for the more than 1,000 employees who resided on the facility. Some of the services available were related to transportation, recreation, and food. Others included the provision of a tire inspection service, which was operated by B.F. Goodrich Co. for a time, and a 24-hour service center for emergency needs. Catholic and Protestant church services were held in the dining room of the cafeteria for permanent residents of the plant and for those who worked the midnight to 8:00 AM shift. Laundry services, a barber shop, and a drug store were available for those who lived on the plant. Homes Registration offices in Ravenna, Newton Falls, and Warren served as subsidiaries of the Plant Housing Division and listed houses, furnished rooms, and sleeping rooms available for rent and/or sale. Services were also provided to help with evictions, rent ceilings, and moving vans. Loans of \$25.00 were available as well to new employees to help them get settled in the area (*ROP*, article a).

Most employees drove to the plant, a mode of transportation that became increasingly regulated after the war started. Atlas instituted a Share-the-Ride program in September 1942, considered one of the best in the



After the coveralls are removed from the "washer", pictured at extreme right, they are placed in one of the two centrifugal driers.

Plate 30. ROP Magazine from May 1942 which shows the laundry operation at the plant. Each of the two large washers daily cleaned between 4,500 and 5,000 uniforms. The Laundry Department was almost entirely composed of African-American workers (*ROP*, article i, Volume 2, No. 5).

country (APC 1943b:499). The company's Plant Transportation Advisory Committee administered the program that matched workers and drivers by destinations and provided certifications to local rationing boards for the occupational gasoline and tire needs of drivers after gas rationing began on December 1, 1942 (APC 1943b:501; *ROP*, article a). An earlier survey that year had shown that the average number of persons per car was 1.6; the goal of the program was four persons per car. On January 1, 1943, 1,257 cars were driven a distance of 20 or more miles to the plant. A check on April 1, 1943, showed that this figure had been reduced to 865 cars and the average number of occupants per car had been increased to 3.69 (U.S. Government 1942:103).

Bus service was arranged for employees with Penn-Ohio Coach Lines, Hawk Bus Line, and the Arsenal Transit Company. The service was maintained from Salem, Lisbon, Youngstown, Akron, Alliance, and intermediate points. In 1943, bus service was patronized by about 20 percent of ROP employees (APC 1943b:506). Train service was available as well. The small passenger station on the B & O railroad line at the plant served commuters from longer distances or those who wanted to travel on the weekend to more distant places (*ROP*, article r).

Recreation was a prominent feature of the workers' lives. The many different agencies and social groups realized that such activities gave newcomers and long-time residents a chance to become acquainted and could help ease some of the tensions (APC 1943b:481). Recreation programs were instituted at the plant during the construction period of 1940-1941 in order to engage more constructively the more transient construction workers. The programs acted as a venue for plant employees to form relationships and to create alliances that would help production.

The Social Federation of Portage County assisted with efforts to obtain the use of the Ravenna Armory on the east side of the town for conversion into a recreation building, which was ultimately managed by the United Service Organization (USO) and the Young Men's Christian Association (YMCA). A new recreation building funded by the Federal Public Housing Authority was built in Newton Falls, the community which

contained most of the defense housing, and was overseen by the USO and the YMCA (APC 1943b:482). A third building operated by the USO was located at the Cotton Corners dormitories which were reserved for women (APC 1943b:482).

Another new recreation center opened in the Administration Area of the plant in June 1943 through funds provided by the Federal Public Housing Authority (FPHA) (APC 1943b:485). The new recreation building included a 650-seat auditorium with a projection room for showing movies, a library, two club rooms, two game rooms, and a billiard room. Beginning in February 1944, the building was open 16 hours daily. Hundreds of people attended the special events held there, including a St. Patrick's Day Dance, departmental parties, and other occasional dances (APC 1944:III:8). Other recreational sports activities included baseball, football, bowling, basketball, badminton, volleyball, ping-pong, and ice skating. Wednesday bingo parties and free golf lessons on Wednesday afternoons were available as well (APC 1945:VII:11; *ROP*, article a).

The plant boasted a large cafeteria in the Administration Area which was ably run throughout both the construction and operating periods by A. M. Lucha, the former assistant manager of the Statler Hotel in Buffalo and a graduate of the hotel administration program at Cornell University (APC 1943b:457). The cafeteria mainly served office employees, residents on the facility, and maintenance workers. A government history of the plant reported that, "[l]unchrooms are provided in the change houses on the load lines, and small canteens are available in the fuze and booster area. There are no milk stations, but candy dispensers and soft drink dispensers are provided. TNT, tetryl and fulminate workers were provided with 100 mg of ascorbic acid daily. Enriched bread was served in the cafeteria at the post. There were four food wagons for carrying hot food to the change houses. Generally, workers bring their own lunches and buy drinks and desserts on the lines" (U.S. Government 1942:91).

Pay

During construction, the wage rate for plant workers was estimated at \$1.00 an hour. This amount, it was believed, "would have a profound effect on wage standards in Ravenna and Kent" (Anonymous, Scrapbook article pp). Henry Lock remembers that he was paid 98 cents an hour as a truck driver for Atlas, which was considered good pay (Lock, interview 1994). Gladys Walters (interview 1994) received 87 cents an hour as a timekeeper when she started work at the Portage Ordnance Depot.

Although there is very little mention of actual wage rates in the Atlas histories, these histories do report continual negotiations and collective bargaining agreements regarding wage increases with the respective unions. A review of hourly rates in bomb and shell loading plants written in early 1945 indicated that most workers at plants in the central United States made under \$1.00 an hour. Men were generally paid more than women for the same job (Olsen 1945:848).

Security

Security was a major feature of daily life at the plant and included guard checks when an employee entered the plant, a tall security fence around the entire plant, exhortations not to discuss the work going on at the plant, and efforts to hire only "thoroughly American" workers (APC 1943b:82). Fingerprinting of employees at the plant commenced during the construction period in July 1941, close to the time that the start-up of loading operations on Line I was to begin. Robert Walters, who started work in September 1940 with Hunkin-Conkey as a guard at the George Road gate, did fingerprinting on the midnight shift in a shanty, which was one of the former farm outbuildings that was fitted on skids so that it could be moved around the plants to go to where the workers were. Once the fingerprinting operations started, it was said that those men who left their jobs soon after probably had something to hide (R. Walters, interview 1994).

Economic and Social Effects of the GOCO Plant on Portage County and Ohio

The ROP and the attendant war-time conversion of many northeastern Ohio industrial facilities had a profound economic and social effect on the county and region. These industries engendered many good-paying jobs for men and women and helped provide a strong sense of purpose. The plant instituted a new source of revenue in the state, which provided a strong base of employment for the Portage County area. The Atlas history quoted an article written in the *Employment Security Review* in May 1942, entitled "Some Problems in Staffing a War Plant," which stated that:

During the past 18 months approximately 1½ billion dollars in war contracts has been left in the State of Ohio. These contracts made necessary large plant expansions, partial and total conversion of plants from civilian to war production, and in a number of instances, occasioned the location of wholly new industries in the State (APC 1943b:84).

The value of the war contracts awarded to the state during World War II amounted to more than \$18 billion ranking Ohio fourth in the country after Michigan, New York, and California. These contracts were for the production of aircraft, ordnance, and shipbuilding, in that order. The Cleveland area was the most important center in the state for these activities (Roseboom and Weisenburger 1976:372).

EFFECTS OF THE END OF THE WAR

As early as February 1944, a War Department Industrial Facilities Inventory speculated on future uses for the Ravenna plant, including the use of the Administration Area as a soldiers' rest home and the use of some of the buildings for private manufacturing enterprises. Although certain areas could be sold off, it was determined that the plant did not lend itself for sale as a complete unit (War Department 1944:210). It was reported as well that the "present operator states that there is no possibility of use of ROP in conjunction with his other properties. It is possible that the operator might purchase equipment items designed primarily for use in the manufacture of ammunition and explosives" (War Department 1944:211).

Subsequent to VE day on May 8, 1945, staff reductions began to occur. At first, voluntary terminations were requested, and then the actual layoff of employees began, which together affected more than 1,000 people. Atlas commented that "[t]hese layoffs, together with cutbacks in other companies throughout the area, affected morale to the extent of making many employees anxious as to their job security" (APC 1945a:VIII:44).

On August 15, 1945, the War Department issued official notice to the plant to discontinue operations and to place it in standby condition for return to the government (APC 1945a:IX:17). Beginning on August 17, many employees were let go, with half of the total personnel expected to be released by the end of the month (*Bombshell*, article b). By September 29, the decontamination program for all the lines was nearly complete (APC 1945a:IX:19). Atlas turned the Ravenna plant over to the government on November 24, 1945 (Voight 1945:2). Since the Ravenna plant was retained for use by the government for standby operations, however, the plant continued to provide employment, though in greatly reduced numbers, for area residents after the war, both at the depot and in ammunition reclamation.

POST-WAR YEARS

In the years immediately following the close of the war, the Ravenna plant was used for several purposes. With the advent of VE Day, the depot was flooded with ammunition from overseas. Ammunition destined for East Coast ports was diverted en route to Ravenna as well as to other East Coast installations (APC 1945a:IX:18). Between 1945 and 1951, the plant was included in the government's Operation Standby

program, which involved the maintenance and storage of equipment and ammunition for quick preparedness in case of future conflicts (Anonymous, Scrapbook article rr).

Tentative plans had been made to utilize the plant facilities for reclamation and renovation of ammunition under government operation (APC 1945a:IX:3). Ammunition was sent to the arsenal for disposal or storage. Explosives were melted out and sold to munitions industries and the recovered metal parts were sold as scrap (CPD 1968). An article in *The East Ohio News* (Anonymous, ca. 1950) stated that "bombs and shells from other depots in the Country have been shipped to Ravenna for reclassification, dismantling of obsolete types, and general storage. . . . So this is Ravenna . . . industrious, important, and still growing. Recognition of its diversified industries is noted by even the casual visitor." From late 1946 until early 1950, the Silas Mason Company of Shreveport, Louisiana, used the old Ammonium Nitrate line to manufacture ammonium nitrate grade fertilizer, most of which was shipped to Europe under the Marshall Plan (MacDonald and Mack 1984:41). That operation employed about 250 people (Anonymous, ca. 1950).

From 1951 until 1957, another contractor, Ravenna Arsenal, Inc., which was a subsidiary of Firestone Tire & Rubber Company, became the operator and took over the loading of shells and anti-tank mines during the Korean Conflict. During that period, over 5,200 people were employed at the arsenal (CPD 1968). In 1957, however, the plant closed down its loading operations (MacDonald and Mack 1984:43-44). A runway on the plant was used by the old National Advisory Committee for Aeronautics, the forerunner of NASA, as the site of experiments relating to fire associated with airplane crashes (CPD 1968). These experiments concentrated on improvements in the design of airplane fuel tanks. With escalation of the Vietnam War (Southeast Asia conflict) during the decade of the 1960s, however, the plant functions again involved the renovation of equipment from other plants and, beginning in 1968, the production of shells, cartridges, and two kinds of primers (MacDonald and Mack 1984:46). Although some renovation and demilitarized operations (the disassembly of ammunition) continued until 1984, the plant was returned to standby status in 1971 (MacDonald and Mack 1984:46). In 1983, the operation of the plant was sold by Firestone to Physics International Company, a subsidiary of Rockcor, Inc., of Seattle, Washington, and Olin Corporation (MacDonald and Mack 1984:47; USAAMCC 1989:4). In 1993, Mason & Hanger-Silas Mason Company, Inc., was awarded a Modified Caretaker Contract (McGee, interview 1994).

As of the present time, the plant mission is the storage and maintenance of explosive material and other industrial stock (Kaspers, interview 1994). Other federal agencies have permits with the U.S. Army for storage and for training exercises to be conducted at the plant, including the FBI and the U.S. Air Force Reserve 910th Tactical Airlift Group (McGee, interview 1994).

ENVIRONMENTAL LEGACY

Environmentally, the Ravenna Ordnance Plant has been left with both the positive and negative results of the policies and practices implemented during the 1940s and the ensuing years. Today, the 21,000-acre facility contains a large natural preserve for many animal and bird species and abundant timber reserves, the latter a result of the conservation practices mandated by the War Department and the Atlas Powder Company. The safety-quantity distances that were observed during the initial layout of the lines placed them far enough apart from each other that, coupled with more than 20 years of disuse of most of the plant buildings, the proliferation of deer, beaver, wood ducks, and other wildlife abounds. Although deer hunts are allowed in the fall, these events have not had a noticeable impact on the wildlife populations.

The built environment of the plant, however, presents extensive environmental problems stemming from the work carried out at the plant during the World War II and subsequent years that have left massive clean-up problems. Materials contained within the buildings are a source of environmental concern, particularly the use of asbestos in wall panels, on the corrugated roofs (which, according to the Hunkin-Conkey history, are

extensive enough to cover an area of 85 acres), and in the insulation wrapped around the above ground steam lines, as well as the use of lead paint during the early years of the plant (McDowell 1941:165).

Soil contamination is present in many parts of the plant. Liquid TNT from all the load lines was poured from the buildings into the old wastewater systems (McGee, interview 1994). The burning grounds and demolitions grounds, in designated areas of the plant, were used for the disposal of ammunition after World War II. The demolition grounds are located just south of the burning grounds and were used to explode defective shells and bombs. Although the old demolition area west of the Fuze and Booster area is rumored to contain dumped mustard gas from the Cold War era, definite evidence of such has yet to be established. Near the demolition grounds, an old runway was used as the site for experimental airplane crashes that were a component in the testing of fuel tank improvements after World War II (McCauslin, interview 1994).

The environmental problems of the site have kept the redevelopment of the plant for civilian use a distant goal. With the increasing inactivity of the plant and the resultant loss of local jobs, politicians, including a former state governor, have proposed redevelopments ranging from industrial parks to a jet airport as a means of gaining local political support. The prohibitive costs of clean-up (estimated at \$6 to \$7 million in 1969) and the army's stated continued need for the facility, however, have prevented any action to date (Anonymous, Scrapbook article qq).

SUMMARY AND CONCLUSIONS

The ROP was the first of the GOCO load, assemble, and pack plants to be authorized for construction in August 1940 by the government. The historic significance of the plant is defined by its well-documented monumental construction effort, the innovative and efficient war materiel production, and the significant and lasting effects that the plant has had on area social and economic structures. The construction effort by the Hunkin-Conkey Company from September 1940 until March 1942, in tandem with the planning aspects provided by the Atlas Powder Company, was the most significant achievement undertaken up to that time in the area and in the state of Ohio. During the construction period, more than 17,000 people were employed at the plant. The Atlas Powder Company contract was unusual in that, as well as being the Operating Contractor during war-time operations--the duty that it officially assumed in March 1942--it had also been paid by the government to provide management services in the initial design, planning, and engineering phases of the plant.

Although limited information was found with regard to land acquisitions, the possible existence of cemeteries within the plant, and the pay scales during the World War II-era plant operations, and few original historic photographs from the World War II-era exist, it was obvious during the investigations that a wealth of historical information exists about the plant and its operations. The present research effort could only document certain aspects of the plant. Many topics that are covered briefly in this report could be more thoroughly researched in the context of the history of the ROP. Some of these topics include the political aspects of the negotiations which influenced the choice of Ravenna for this GOCO plant, in particular the specific efforts of Congresswoman Frances Bolton and Congressman Dow Harter. The experience of women and African-Americans who were employed at the plant was briefly discussed but should be given more study. An in-depth analysis of the industrial and technical importance of the Ravenna plant in the context of northeastern Ohio war production efforts is another area of recommended future research. Further study could also be focused on an examination of the social effects of the war and the consequences of the presence of this plant on the defense workers and the other residents of the region.

REFERENCES CITED

- Anonymous
1942 *History Ravenna Ordnance Plant*. September 1940-December 1942. Document on file at the Administration Building #1037, RVAAP, Apco, Ohio.
- 1943 *Historical Report, Portage Ordnance Depot*. 27 October 1941-15 July 1943. Document on file at the Administration Building #1037, RVAAP, Apco, Ohio.
- ca. 1950 *East Ohio News*. Article on file at RVAAP Administrative Offices. Administration Building #1037, RVAAP, Apco, Ohio.
- Various Five untitled and unnumbered scrapbooks containing articles about the Ravenna Ordnance Plant carried in various area newspapers. Scrapbooks on file, RVAAP, Apco, Ohio.
- a. Armory is Sought for Play Center. *Akron Beacon-Journal*, 12 August 1944.
 - b. Arsenal Bonanza to Akron Unions. Unidentified newspaper, no date.
 - c. Arsenal Cuts Portage Crops. *Akron Beacon-Journal*, no date.
 - d. Arsenal Doubles Business of Windham's Small Post Office. Unidentified newspaper, no date.
 - e. Arsenal Guard Beaten; 3 Held. *Ravenna Evening Record*, 7 January 1941.
 - f. Arsenal Moving Order to Stand. Unidentified newspaper, no date.
 - g. Arsenal Skilled Men Indicate They Will Work This Weekend. *Ravenna Evening Record*, 7 August 1944.
 - h. Asks U.S. to Pay Portage for Lost Tax. *Ravenna Evening Record*, 11 February 1941.
 - i. Atlas Powder Company Reveals Housing Needs. Unidentified newspaper, no date.
 - j. C.I.O. is Silent in Arsenal Fight. Unidentified newspaper, no date.
 - k. Cook to Appoint Price Committee. *Akron Beacon-Journal*, 9 August 1941.
 - l. Construction of Ravenna Ordnance Plant Results in Portage Agricultural Changes. *Ravenna Evening Record*, 25 February 1941.
 - m. The Czars at Ravenna. *Akron Beacon-Journal*, 4 August 1941.
 - n. Erie Commuters to Arsenal No Problem in Kent Parking. *Ravenna Evening Record*, 1 March 1941.
 - o. Farmers Ousted by Plant, Sought. Unidentified newspaper, no date.
 - p. Heater, Shower in Every Room, and Cost is Only \$3.50 Weekly. Unidentified newspaper, no date.
 - q. Housing of 6,000 Workers Presents Arsenal Problem. Unidentified newspaper, no date.

- r. Key Citizens Discuss Social Problems of Portage County. Unidentified newspaper, no date.
- s. National Bank to Stay Open Friday Nights. *Ravenna Evening Record*, 26 February 1941.
- t. Newton Falls 'Blooms' at Night as Defense Workers Pour into Cafes to Quench Thirst; Rooms at Premium; Warren Pays Little Heed to Arsenal. Unidentified newspaper, no date.
- u. Ohio, U.S. Engineers Adopt Arsenal Road Construction Plans. *Ravenna Evening Record*, no date.
- v. Ordnance Plant At Ravenna Will Hire 3,000 Girls. *Ravenna Evening Record*, no date.
- w. Ordnance Works Cuts WPA Ranks. Unidentified newspaper, no date.
- x. Pay Bonanza is Left Open to Beer Joints. *Akron Beacon-Journal*, 12 February 1941.
- y. Private Cash to Finance Ravenna Housing Work. Unidentified newspaper, no date.
- z. Railroad Opens Probe of Wreck at Arsenal. Unidentified newspaper, no date.
- aa. Ravenna Awaits Business Boom. Unidentified newspaper, no date.
- bb. Ravenna Housing Will Start May 1. Unidentified newspaper, March 1941.
- cc. Ravenna Trailers will Open Soon. *Akron Beacon-Journal*, 5 August 1942.
- dd. Saloons Ravenna Banks on Payday at Arsenal, unidentified newspaper, 8 February 1941.
- ee. Seek Chavin's Aid in Road Extension. Unidentified newspaper, no date.
- ff. See U.S. Housing at Ravenna Plant. Unidentified newspaper, no date.
- gg. Skilled Men Work Today at Arsenal. *Ravenna Evening Record*, 9 August 1941.
- hh. State Engineers to Study Arsenal Health Conditions. *Ravenna Evening Record*, 25 February 1941.
- ii. Survey Indicates County Could Use 596 Rural Defense Homes. Unidentified newspaper, 7 March 1941.
- jj. Transient Labor Worries Ravenna. *Akron Beacon-Journal*, no date.
- kk. Warn Against Rt. 627 Parking. *Ravenna Evening Record*, no date.
- ll. 5 Plants Hit by Walkout. *Youngstown Vindicator*, 3 August 1941.
- mm. 10% of Arms Plant Workers From Warren. Unidentified newspaper, no date.
- nn. 4,500 Will Get Construction Jobs on \$14,000,000 Arsenal. Unidentified newspaper, no date.
- oo. 1,000 Push Ravenna Arms Camp Job. *Akron Beacon-Journal*, 19 October 1940.
- pp. Hillyer Explains Arsenal Plans. Unidentified newspaper, no date.
- qq. A Serene Setting Hides Tools of War. *Akron Beacon-Journal*, 17 April 1943.
- rr. Arsenal Keeps Equipment Ready for War-Time Use. *Ravenna Evening Record*, 24 February 1949.
- ss. Army at Work on \$18,000,000 Ordnance Early 1941. Unidentified newspaper, no date.

Atlas Powder Company (APC)

- 1942 *Survey of Federal Housing Projects, Warren-Ravenna Area*, Ravenna Ordnance Plant, Industrial Relations Department, Division of Housing, 28 October. On file at the Administration Building #1037, RVAAP, Apco, Ohio.
- 1943a *Original Property Owners' Map*, Drawing No. 6001. Stored in the Engineering Vault, Administration Building, RVAAP, Apco, Ohio.
- 1943b *History of the Operating Contractor's Organization and Operation of the Ravenna Ordnance Plant*. Apco, Ohio. On file at the Old Administration Building #1030, RVAAP, Apco, Ohio. Volume I, 28 August 1940 - 30 June 1943.

- 1944 *History of the Ravenna Ordnance Center*
 Volume III, 1 January 1944 - 31 March 1944
 Volume IV, 1 April - 30 June 1944
 Volume V, 1 July - 30 September 1944
 Volume VI, 1 October - 31 December 1944
- 1945a Volume VII, 1 January 1945 - 31 March 1945
 Volume VIII, 1 April - 30 June 1945
 Volume IX, 1 July - 30 September 1945
- 1945b *Total Production Report of Ravenna Ordnance Plant*, Atlas Powder Company, 29 August.
 Chart in possession of Carl Bauman, Newton Falls, Ohio.
- The Bombshell* [Apco, Ohio]
 1944-1945 Atlas Powder Company newspaper of the Ravenna Ordnance Plant, Apco, Ohio. 6 July 1944 to 17 August 1944. Located in Ravenna Arsenal file at the Reed Memorial Library, Ravenna, Ohio.
- a. Fishing and Picking Fruit Now Permitted. 6 July 1944:5.
 - b. Our War Job is Finished. 20 August 1945:1.
 - c. Whaddya Do on Booster II? 5 September 1944:3.
- Chandler, A. D., Jr., and S. Salisbury
 1917 *Pierre Du Pont and the Making of the Modern Corporation*. Harper & Row, New York.
- Cleveland Plain Dealer (CPD)* [Cleveland, Ohio]
 1968 Ammo Plant is Cranking Up. 30 July. Framed article at the Administration Building #1037, RVAAP, Apco, Ohio.
- Darbee, J., and J. Williams
 1994 National Register nomination of the Cleveland Bomber Plant, Brook Park, Ohio. Nomination on file at the Ohio Historic Preservation Office. Ohio Historic Society, Columbus.
- Decker, Estella
 1994 World War II employee of RVAAP. Oral history interview conducted in August 1994 by Rita Walsh of Gray & Pape, Inc., for Geo-Marine, Inc. Tape on file at U.S. Army Corps of Engineers, History Office, Fort Belvoir.
- Derdak, T. (editor)
 1988 *International Directory of Company Histories, Vol. 1*. St. James Press, Chicago.
- Dipaolo, R.
 1991 Ravenna Arsenal Stands as a Modern Marvel. *Ravenna Courier*, 25 August. Article on file at Ravenna Arsenal File, Reed Memorial Library, Ravenna, Ohio.
- The Evening Record/Daily Courier-Tribune* [Ravenna, Ohio]
 1940a U.S. To Build \$10,000,000 Arsenal Near Ravenna. 15 August:1.
- 1940b The Munitions Loading Plant. 19 August:2.
- Gorisek, Sue
 1986 Ravenna. *Ohio Magazine* October:9(7):15-18.

- Hayes, T. J., Lieutenant Colonel
1938 *Elements of Ordnance*. Wiley & Sons, New York.
- Hunkin-Conkey Construction Company
n.d. *Ravenna Arsenal, Apco, Ohio, Class "A" Construction Photographs--Hunkin-Conkey Construction Company*. Book No. 4. On file at the Administration Building #1037, RVAAP, Apco, Ohio.
- Kane, K. L.
1994 *Historical Context for the World War II Ordnance Department's Government-Owned Contractor-Operated (GOCO) Industrial Facilities, 1939-1989*. Geo-Marine, Inc., Plano Texas. Submitted to U.S. Army Corps of Engineers, Fort Worth District.
- Kaspers, Robert
1994 Commander's Representative at RVAAP. Informal interview conducted in August 1994 by Rita Walsh of Gray & Pape, Inc., for Geo-Marine, Inc..
- Lock, Henry
1994 World War II employee of RVAAP. Oral history interview conducted in August 1994 by Rita Walsh of Gray & Pape, Inc., for Geo-Marine, Inc. Tape on file at U.S. Army Corps of Engineers, History Office, Fort Belvoir.
- MacDonald and Mack Partnership (MacDonald and Mack)
1984 *Historic Properties Report: Ravenna Army Ammunition Plant, Ravenna, Ohio*.
- McCauslin, Sue
1994 Environmental Specialist, consultant to Mason & Hanger-Silas Mason Company, Inc. Informal interview conducted in August 1994 by Rita Walsh of Gray & Pape, Inc., for Geo-Marine, Inc.
- McDowell, L. L. (editor)
1941 *Building the Ravenna Ordnance Plant: A Job History*. Hunkin-Conkey Construction Company, Cleveland.
- McGee, James
1994 Security/Facilities Supervisor at RVAAP. Informal interview conducted in August 1994 by Rita Walsh of Gray & Pape, Inc., for Geo-Marine, Inc.
- Morgan, Timothy
1994 Forester at RVAAP. Informal interview conducted in August 1994 by Rita Walsh of Gray & Pape, Inc., for Geo-Marine, Inc.
- Murphey, J. S.
1993 *Building the Arsenal of Democracy: A Survey of the World War II Military-Industrial Army Ordnance Complex*. Unpublished document on file at the U.S. Army Corps of Engineers, Fort Worth District.
- Olsen, E. M.
1945 Hourly Earnings in the Ammunition-Loading Industry, 1944. *Monthly Labor Review* April:60:837-851.

- Paul, Maurice
1994 Interview conducted via telephone in August 1994 by Rita Walsh of Gray & Pape, Inc., for Geo-Marine, Inc.
- Polenberg, R. (editor)
1968 *America at War: The Home Front, 1941-1945*. Prentice-Hall, Englewood Cliffs, New Jersey.
- Quayle, L. A.
1945 Volumetric Pouring Machine. *Mechanical Engineering* September:67:599-606.
- Ravenna Ordnance Plant (ROP)*
1941-1943 Atlas Powder Company magazine produced for the Ravenna Ordnance Plant, Apco Ohio, from July 1941 to July 1943. Copies of the magazines are in the possession of Robert Walters and Estella Decker, both of Ravenna, Ohio.
- a. Employe [sic] Services . . . at your fingertips. Volume 3, Number 1, January 1943.
 - b. Key Men of the Ravenna Plant. Volume 1, Number 1, July 1941.
 - c. Learn Your Job the Easy Way. Volume 2, Number 2, February 1942.
 - d. Shell loading: A New Industry for Ohio. Volume 1, Number 2, August 1941.
 - e. We Fight When We Produce. Volume 2, Number 9, September 1942.
 - f. Home Sweet Home for 100 Arsenal Workers' Families. Volume 1, Number 4, October 1941.
 - g. Housing Situation Becomes More Acute as Operations Begin. Volume 1, Number 1, July 1941.
 - h. How Shells are Loaded. Volume 1, Number 3, September 1941.
 - i. Our Laundry. Volume 2, Number 5, May 1942.
 - j. Period of Transition. Volume 1, Number 1, July 1941.
 - k. Safe Practices Provide Security for Defense. Volume 1, Number 5, November 1941.
 - l. Women Help Raise Production Ceiling. Volume 3, Number 2, February 1943.
 - m. Women Workers Defended. Volume 3, Number 7, July 1943.
 - n. War Department News--Ravenna Ordnance Center. Volume 3, Number 5, May 1943.
 - o. Ordnance Inspectors Keep 'Em Shooting. Volume 2, Number 6.
 - p. R.O.P. Wins Army-Navy 'E' Award. Volume 3, Number 4, April 1943.
 - q. Over 3,000 Attend Colorful Ceremony. Volume 3, Number 5, May 1943.
 - r. Passenger Trains Now Stop at Apco. Volume 2, Number 11, November 1942.
 - s. R.O.P. Awarded Minuteman Flag. Volume 2, Number 7, July 1942.
 - t. Safety--begins at home. Volume 2, Number 8, August 1942.
 - u. A Full House Still Beats Three of a Kind! Volume 3, Number 2, February 1943.
 - v. Hitler-Hirohito "E" Awards. Volume 3, Number 4, April 1943.
- Roseboom, E. H., and F. P. Weisenburger
1976 *A History of Ohio*. The Ohio Historical Society, Columbus.
- Stafford, B., H. Hassen, E. Jelks, J. Phillippe, E. Hajic, N. Asch, D. Asch
1984 *An Archeological Overview and Management Plan for the Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio*. Report No. 4, Center for American Archeology, Kampsville, Illinois, subcontractor, for Woodward-Clyde Consultants, Walnut Creek, California. Under Contract CX-5000-3-0771 with the National Park Service, U.S. Department of the Interior, for the U.S. Army Materiel Development and Readiness Command.

- Taylor, G. D., and P. E. Sudnick
1984 *Du Pont and the International Chemical Industry*. Twayne Publishers, Boston.
- Troyer, L. C.
1986 A Reporter's "Dream Scoop" Became Ravenna Arsenal. *The Ravenna Daily Courier-Tribune*, 23 August. On file at the Administration Building #1037, RVAAP, Apco, Ohio.
- ?UNAMEIT?
1944 Initial name (one issue only) of the Atlas Powder Company newspaper of the Ravenna Ordnance Plant, Apco, Ohio. The newspaper was renamed *The Bombshell*. On file in the Ravenna Arsenal file at the Reed Memorial Library, Ravenna Ohio.
a. Col. Meldrum, C.O., Reveals R.O.C. Safer Than Home. 6 July:3.
b. Lost! 550 Man Days. 6 July:3.
c. Need for More Men is No Pipe Dream. 6 July:1
- Urban, Karl
1994 Property Administrator, RVAAP. Informal interview conducted in August 1994 by Rita Walsh of Gray & Pape, Inc., for Geo-Marine, Inc.
- U.S. Army Armament, Munitions and Chemical Command (USAAMCC)
1989 *Installation Profile Ravenna AAP, Fiscal Year 1989*. Rock Island, Illinois. On file at the Administration Building #1037, RVAAP, Apco, Ohio.
- U.S. Geological Survey (USGS)
1909 Topographic maps: Warren and Ravenna Quadrangles, 15 minute series.
- U.S. Government
1942 *History Ravenna Ordnance Plant 1940-1942*. Photocopied document on file at the Administration Building #1037, RVAAP, Apco, Ohio.

n.d. Series of untitled books containing photographs and physical information of all facility buildings, pages entitled Historical Records of Ravenna Ordnance Plant. Book on file in the Engineering Vault, Old Administration Building #1030, RVAAP, Apco, Ohio.
- Voight, W., Jr.
1945 *Ordnance War Administration History*, Series II: The Ordnance Organization in World War II, Study No. 11: Facilities, Monograph No. 1: GOCO Facilities - Directory. Original on file at Rock Island Arsenal Historical Archives, Rock Island, Illinois.
- Walters, Robert Boyd, and Gladys
1994 World War II employees of RVAAP. Oral history interview conducted in August 1994 by Rita Walsh of Gray & Pape, Inc., for Geo-Marine, Inc. Tape on file at U.S. Army Corps of Engineers, History Office, Fort Belvoir.
- War Department
1943 *Completion Report for Ravenna Ordnance Plant, Jobs Nos. 41-1, 42-1, and M-1*. U.S. Corps of Engineers.

1944 *Industrial Facilities Inventory: Ravenna Ordnance Plant, Apco, Ohio*. U.S. Engineer's office. Pittsburgh.

Wilbur Watson and Associates

- n.d. Ledger Book of reduced-size copies of the original architectural plans by Wilbur Watson and Associates, Cleveland, Ohio. Stored in the Engineering Vault, Old Administration Building #1030, RVAAP, Apco, Ohio.

Williams, Peggy

- 1994 World War II employee of RVAAP. Oral history interview conducted in August 1994 by Rita Walsh of Gray & Pape, Inc., for Geo-Marine, Inc. Tape on file at U.S. Army Corps of Engineers, History Office, Fort Belvoir.

Works Progress Administration (WPA)

- 1940 *The Ohio Guide*. Ohio Writer's Project, Oxford University Press, New York.

Youngstown Vindicator

- 1951 Ravenna Arsenal Booms Again. Framed article, 9 December. In Administrative Building #1037, RVAAP, Apco, Ohio.